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# MICROWAVE

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**The European journal for the microwave and wireless design engineer**

# We've Pushed The Technology Envelope.



## Our New Hybrid Power Modules Now Provide High Output Power Levels Across An Instantaneous BW From 4-18 GHz.

AR's new line of Hybrid Power Modules (HPM's) are small, compact and lightweight, but they're big on power and performance. Our standard products deliver up to 5 watts of output power with excellent linearity, gain flatness and the ability to withstand infinite output mismatches.

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## IN BRIEF

**Eutelsat acquires GE-23 to expand in Asia-Pacific**

Eutelsat Communications has announced it has concluded negotiations to acquire the GE-23 satellite, associated customer contracts and orbital rights from GE Capital for US\$228 million. The transaction is expected to close in the second half of 2012 (calendar), subject to regulatory approvals.

Built by Thales Alenia Space, GE-23 was launched in December 2005 and has an expected useful life of 15 years. From its location in geostationary orbit at 172 degree(s) E, the satellite offers unique coverage over the Asia-Pacific region via a payload of 20 Ku-band transponders accessing five interconnecting beams and 18 C-band transponders connected to a trans-Pacific beam. Leveraging its comprehensive coverage and high-bandwidth capability, GE-23 offers a broad range of telecom services to a diverse base of blue chip customers. [www.eutelsat.com](http://www.eutelsat.com)

**LTE handover between TD and FDD demonstrated**

Altair Semiconductor has announced that its FourGee-3100/6200 chipset successfully completed TD/FDD LTE live handover testing with Rohde & Schwarz. The test, which employed Altair's FourGee™ chipset in an end-user device, successfully enabled seamless communication between different LTE modes, achieving an uninterrupted and continuous data session with low handover latency from a 20 MHz TD-LTE channel and a 10 MHz FDD channel and back.

Altair claims to be the first chipset manufacturer to achieve live TD/FDD LTE handover in commercially available devices. By allowing the two LTE duplex modes to operate interchangeably on the same device, as well as enabling global LTE roaming, this achievement has significant market implications. [www.altair-semi.com](http://www.altair-semi.com)  
[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Mindspeed adds support for smart DAS into small cells

Mindspeed Technologies has integrated support for smart Distributed Antenna Systems (DAS) technology into its range of System-on-Chip (SoCs) for small cell products. With this capability, the company can support 'hybrid' systems, with small cell base stations feeding DAS equipment, extending the opportunities for small cells and bringing new value to companies currently developing DAS products.

Until now, chips for small cells have been unable to support DAS but Mindspeed's PC333 and PC3032 products have added specific support to deal with the delay characteristics of the long coaxial networks and the specific antenna technology associated with DAS. The PC333 and PC3032 are expressly designed for high-perfor-

mance public access small cells that serve urban hot spots, city centers and dense in-building systems. They are the only small cell SoCs that support 3GPP Local Area Base Station (LABS) performance and soft handover (SHO) standards.

Traditional DAS solutions channel radio frequencies and provide excellent coverage for large buildings, underground tunnels, shopping malls and areas difficult to penetrate using outdoor macro cells. Today the biggest challenge facing operators is enabling excellent coverage while maintaining the capacity to support ever-increasing amounts of data. This is where small cells can provide a solution.

[www.mindspeed.com](http://www.mindspeed.com)

## Broadband VNA system for on-wafer characterization covers 70 kHz to 140 GHz

Anritsu Company has demonstrated the only broadband Vector Network Analyzer (VNA) system that can conduct single sweeps from 70 kHz to 140 GHz at the International Microwave Symposium (IMS), in Montreal.

A number of higher frequency bands are gaining popularity, including 40-60 GHz for data transmission wireless backhaul between base stations, 60 GHz for Wireless LAN transmission in home and public locations, 77 GHz automotive collision avoidance systems, and 94 GHz for

airport radar applications, materials measurement, and homeland security imaging systems.

The demonstration showcased the company's latest technology, including a 0.8 mm connector, the excellent stability and RF performance of the VectorStar vector network analyzer and mm-wave modules. The system conducted a single sweep across multiple coax and waveguide bands, eliminating the need to use separate systems.

[www.anritsu.com](http://www.anritsu.com)

## ADS system simulation model helps development of Envelope Tracking systems

The OpenET Alliance, the industry association that promotes energy efficient wireless transmission through Envelope Tracking (ET), has today announced the availability of a new High Dynamic Range system simulation model for handset Envelope Tracking applications.

The ET System Simulation model, jointly developed by OpenET members Nujira and the University of Firenze, aids system optimization by making it easier for designers to identify sources of noise and distortion and to make the necessary

design tradeoffs. The System Simulation model, which has been developed using Agilent's Advanced Design System (ADS), provides a framework to model a complete handset ET system, and incorporates a High Dynamic Range (HDR) RF Power Amplifier model developed by Nujira.

The model is suitable for use by chipset designers, PA vendors, filter manufacturers and handset OEMs, and is being released to members of the OpenET Alliance for download from: [www.open-et.org](http://www.open-et.org)

## IN BRIEF

**T-Mobile deploying LTE Release 10 network**

In an effort to leapfrog AT&T and Verizon, T-Mobile is deploying base stations for what it hopes will be the first cellular network to support Release 10, the next generation of LTE. The carrier hopes to go live with the network in 2013 as an adjunct to its existing HSPA+ service.

Release 10 supports carrier aggregation, the ability to use separate spectrum bands in a single service. It also supports up to 40 MHz channels and up to 8x8 MIMO antennas.

Carrier aggregation is seen as a key for a cellular industry starved for spectrum, particularly for T-Mobile which operates out of non-adjacent bands. T-Mobile is expected to spend about \$4 billion over the next year putting in its LTE Release 10 network running over its AWS bands.

[www.t-mobile.com](http://www.t-mobile.com)

**LTE patent pool to include over 20-members**

Via Licensing will roll out in the next few months a patent pool for 4G LTE cellular technology with more than 20 members including AT&T. The effort comes as two other LTE licensing efforts are said to have fizzled.

A growing number of patents, patent holders and law suits is threatening the health of the mobile industry, said panelists debating the issue at the NGMN Alliance conference. Experts are mixed about how much the new pool will help. Even proponents of the pool said the industry also needs to define reasonable licensing terms, especially for patents essential to standards.

The group is now in final review of flat-rate licensing terms it will offer. Exactly who are members of the pool and what patents they have remains confidential.

As many as 3,000 LTE patents have been identified to date, about twice the number as exist for 3G, said Luigi Licciardi, head of technology planning for telecom Italia.

[www.vialicensing.com](http://www.vialicensing.com)

## Carrier Wi-Fi equipment market to grow to \$2.2 Billion by 2017

Global revenue for carrier Wi-Fi access points and controllers will reach \$2.2 billion in 2017 to reach a level equivalent to almost one-half of the traditional enterprise or consumer/SoHo Wi-Fi segments in the same period, according to ABI Research. The majority of the total market in 2011 was accounted for by Cisco, Ruckus Wireless, and Ericsson/BelAir, and as traditional mobile infrastructure vendors add Wi-Fi to their portfolios, these early market share rankings will fluctuate. Carrier Wi-Fi is defined as Wi-Fi that is provided as a service to mobile carrier customers, owned and operated directly or indirectly by the carrier, e.g., a third party hotspot provider.

Nick Marshall, principal analyst, mobile networks, comments, "While carrier Wi-Fi is still

in relative infancy today, the drive by mobile operators to offload data traffic is providing a significant boost to this segment of the market."

The rollout of carrier Wi-Fi has been hampered up until now by the lack of standards which make the process seamless and transparent for the subscriber. "We believe that with standardization initiatives well under way, like Hotspot 2.0 and the almost universal inclusion of Wi-Fi in every smartphone, PC, and tablet being built today, carrier controlled Wi-Fi is expected to see wide-scale adoption, especially in markets like North America, Japan, and South Korea," continues Marshall.

[www.abiresearch.com](http://www.abiresearch.com)

## GaN goes mainstream as costs drop

Recognized as a compelling alternative to silicon for many RF applications, GaN (gallium nitride) technology has generated significant industry interest due to its performance advantages, but has faced significant challenges related to cost — until now.

At the IEEE MTT-S International Microwave Symposium in Montreal, NXP Semiconductors demonstrated its full portfolio of first-generation GaN products, and discussed its vision and roadmap related to GaN. Core to that vision is the concept of "mainstream GaN" — bringing economies of scale and over 30 years of experience in RF power transistors to enable innovation and a secure, reliable supply chain for RF GaN products.

NXP currently offers samples of its first-generation GaN products, including the CLF1G0035-50 and CLF1G0035-100 amplifiers for 50 W and 100 W broadband applications. At IMS2012, the company demonstrated live application examples, including a multi-stage GaN line-up covering a 200 to 2700 MHz frequency band. Using the CLF1G0060-10 driver, and the CLF1G0035-50 amplifier for the output stage, the GaN line-up features 50 V GaN technology and best-in-class linearity. Due to the higher impedance levels of the 50 V GaN process, broadband amplifiers can be designed on a single transistor.

Based on a 0.5  $\mu$ m gate-length technology developed in collaboration with the Fraunhofer IAF Institute in Freiburg, as well as United Mono-

lithic Semiconductors (UMS) in Ulm, Germany, NXP's first-generation GaN amplifiers deliver high linearity without compromise in power, ruggedness and efficiency, significantly reducing component count and amplifier footprint. This collaboration with UMS and Fraunhofer IAF Institute also establishes a Europe-based supply chain for GaN technology.

At IMS2012, NXP also showcased advanced applications using GaN, including a live Class E amplifier tuned for 2.45-GHz, showing the breakthrough efficiency enabled by GaN. Featuring a transistor with internal Class E harmonic matching, the amplifier achieves best-in-class efficiency of 75.2% at 24 W at 2.45 GHz. Based on a 0.25  $\mu$ m gate-length technology currently under development, the company plans to make its high-efficiency Class E narrow-band GaN solutions available in 2013.

NXP is also developing a digital power amplifier using GaN switching transistors that offer higher efficiency than linear amplifiers. These switched-mode power amplifiers (SMPAs) can be used in multiple bands without any modification to the hardware, and will be a key driver of the "ultimate" base station of the future. Like the company's other GaN processes, the 0.25  $\mu$ m GHSM process uses SiC substrates for better reliability, superior RF performance, and enhanced thermal management.

[www.nxp.com](http://www.nxp.com)



# RFMD.

## MMIC VCO Series



The RFMD® RFVC18xx series is a family of voltage-controlled oscillators (VCOs) based on GaAs InGaP MMIC technology. The monolithic structure of the VCO ensures excellent temperature, shock, and vibration performance. With both broadband and narrowband options available, VCOs in this series are capable of operation ranging from 7GHz through 15GHz. Typical applications include point-to-point radio, military, satellite communications, test instrumentation, industrial and medical, aerospace, and CATV. All products in the family operate from a single positive supply voltage and deliver low phase noise performance with minimum power consumption. Each VCO comes in a compact, RoHS-compliant QFN package.

### NARROWBAND MMIC VCOS WITH INTEGRATED FO/2, FO/4 DIVIDER

Freq Range (Min) (MHz)	Freq Range (Max) (MHz)	V <sub>TUNE</sub> (V)	Phase Noise (dBc/Hz at 10kHz)	Phase Noise (dBc/Hz at 100kHz)	V <sub>CC</sub> (V)	P <sub>OUT</sub> (dBm)	Part Number
7300	8200	1.5 to 14.5	-91	-115	5.0	10.0	<a href="#">RFVC1831</a>
7800	8800	1.5 to 14.5	-90	-115	5.0	9.0	<a href="#">RFVC1832</a>
8400	9600	1.5 to 14.5	-90	-114	5.0	8.0	<a href="#">RFVC1833</a>
9000	10200	1.5 to 14.5	-90	-114	5.0	9.0	<a href="#">RFVC1834</a>
9600	10800	1.5 to 14.5	-88	-114	5.0	8.0	<a href="#">RFVC1835</a>
10400	11600	1.5 to 14.5	-89	-113	5.0	8.0	<a href="#">RFVC1836</a>
11100	12500	1.5 to 14.5	-88	-113	5.0	8.0	<a href="#">RFVC1837</a>
11400	12800	1.5 to 14.5	-87	-113	5.0	8.0	<a href="#">RFVC1838</a>
12400	13900	1.5 to 14.5	-87	-112	5.0	8.0	<a href="#">RFVC1839</a>
13600	14900	1.5 to 14.5	-84	-110	5.0	7.0	<a href="#">RFVC1840</a>
9300	10700	1.5 to 14.5	-90	-115	5.0	8.0	<a href="#">RFVC1842</a>
9800	11300	1.5 to 14.5	-90	-114	5.0	7.0	<a href="#">RFVC1843</a>
10500	12100	1.5 to 14.5	-88	-113	5.0	7.0	<a href="#">RFVC1844</a>

### BROADBAND MMIC VCOS WITH INTEGRATED RF OUTPUT BUFFER

Freq Range (Min) (MHz)	Freq Range (Max) (MHz)	V <sub>TUNE</sub> (V)	Phase Noise (dBc/Hz at 10kHz)	Phase Noise (dBc/Hz at 100kHz)	V <sub>CC</sub> (V)	I <sub>D</sub> (mA)	P <sub>OUT</sub> (dBm)	Part Number
8000	12000	0.0 to 13.0	-66	-93	5.0	55	4.0	<a href="#">RFVC1800</a>
5000	10000	0.0 to 18.0	-72	-96	5.0	52	3.0	<a href="#">RFVC1801</a>
4000	8000	0.0 to 18.0	-74	-99	5.0	53	4.0	<a href="#">RFVC1802</a>
6000	9000	0.0 to 15.0	-73	-97	5.0	53	3.5	<a href="#">RFVC1803</a>

### NARROWBAND MMIC VCOS WITH INTEGRATED RF OUTPUT BUFFER

Freq Range (Min) (MHz)	Freq Range (Max) (MHz)	V <sub>TUNE</sub> (V)	Phase Noise (dBc/Hz at 10kHz)	Phase Noise (dBc/Hz at 100kHz)	V <sub>CC</sub> (V)	I <sub>D</sub> (mA)	P <sub>OUT</sub> (dBm)	Part Number
4450	5200	1.5 to 14.5	-84	-108	3.0	43	8.0	<a href="#">RFVC1821</a>
5000	5500	0.0 to 12.0	-80	-103	3.0	45	9.0	<a href="#">RFVC1822</a>
6100	6750	0.0 to 10.0	-76	-101	3.0	37	8.0	<a href="#">RFVC1823</a>
7200	8300	1.5 to 14.0	-80	-106	3.0	65	12.0	<a href="#">RFVC1824</a>
7800	8700	0.0 to 12.0	-80	-107	3.0	67	11.0	<a href="#">RFVC1825</a>
6800	7400	0.0 to 12.0	-80	-103	3.0	70	12.0	<a href="#">RFVC1829</a>



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Mobility. Connectivity. Energy.

## IN BRIEF

**Samsung acquires WLAN developer, Nanoradio**

Samsung Electronics Co. Ltd., has acquired Nanoradio AB, a developer of ultra low power wireless LAN chipsets for high-speed wireless access in mobile phones.

Headquartered in Kista, Sweden, Nanoradio is a “fabless” company with approximately 60 employees and extensive experience in the wireless industry. In particular, Nanoradio specializes in developing small form factor high performance Wi-Fi chipsets with low power consumption for cellular platforms.

Nanoradio's Wi-Fi chips target a range of applications, including mobile phones, wireless network cameras for home surveillance, portable media players and gaming devices. Another big area for Nanoradio is the growing fixed-mobile convergence market with dual-mode phones.

[www.nanoradio.com](http://www.nanoradio.com)  
[www.samsung.com](http://www.samsung.com)

**O2 launches UK M2M network**

Telefonica UK is working with Jasper Wireless to deploy an automated platform for the management of machine-to-machine (M2M) connections on the O2 cellular network.

The cloud-based management platform will enable Telefonica UK customers to roll out connected devices quickly and efficiently, manage them in real time and deliver global support. Jasper Wireless' Control Centre is a software-as-a-service (SaaS) platform that provides customers with global visibility of all SIMs connected to the mobile network. It allows customers to quickly distribute connected devices with robust self-service tools for provisioning, real-time diagnostics and usage controls. It provides powerful intelligence with a live view of how devices are connecting to and using the mobile network.

<http://o2.m2m.com>

## Data growth to make small cells an indispensable part of LTE rollouts

Mobile networks are exploding with many users streaming video simultaneously, putting a huge strain on 4G/LTE, and small cells will create solutions for vendors in the market, according to the latest report from Heavy Reading 4G/LTE Insider, a paid research service of Heavy Reading.

The report, ‘The New 4G/LTE Radio: Small Cells & New Architectures’ examines the small cell market, focusing on how small cells and new network architectures will affect 4G/LTE offerings. It analyzes the mobile landscape, explores drivers and threats in the market, and evaluates new solutions available.

“Sooner or later mobile networks are doomed to buckle under the load of billions of mobile broadband users all streaming video at the same

time,” notes Claus Hetting, research analyst with Heavy Reading 4G/LTE Insider and author of the report. “One solution is for operators to build networks that offer a very high network capacity, exceeding 1 Gbit/s per square kilometer, by increasing 4G/LTE base station density through mass deployment of small cells.”

Small cells and new architectures are starting to form an indispensable part of the 4G/LTE, says Hetting. “While some constitute the natural small cell extension of carrier-grade radio network equipment, other vendors are approaching the small cell market with enterprise and residential femtocell-type equipment,” he continues.

[www.heavyreading.com/research](http://www.heavyreading.com/research)

## GPS/GNSS IC market to reach 1.8 billion shipments by 2016

GPS/GNSS is moving beyond cellular and traditional navigation markets, representing a market of over \$3.3 billion in 2016, according to ABI Research. GPS/GNSS has always been strongly tied to car navigation, personal navigation devices (PND), and cellular space. However, it is now finding applications in cameras, gaming, and tablets. Furthermore, femtocells and small cells represent huge volume opportunities, with companies like u-blox, Fastrax, and iPosi all developing specific GPS/GNSS solutions for this market.

Senior analyst, telematics and navigation, Patrick Connolly says, “Ultimately, GPS/GNSS manufacturers will need to combine an increasing number of technologies, supporting ubiquitous indoor and outdoor location.”

ABI Research's market data, “GPS IC and Devices Forecasts, Global,” provides forecasts of GPS/GNSS ICs and market shares across nine key CE devices.

[www.abiresearch.com](http://www.abiresearch.com)

## Thales and Nokia Siemens to offer LTE broadband for professional mobile radio

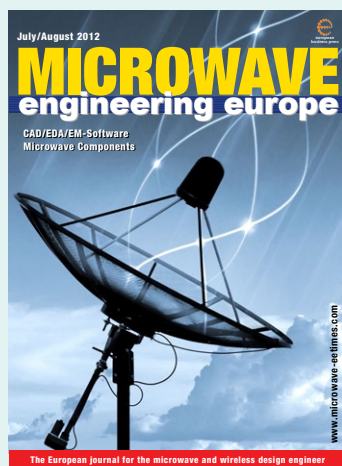
Thales and Nokia Siemens Networks have signed a memorandum of understanding to provide broadband LTE that offers high speed data communication to professional mobile radio users. This cooperation covers Europe, the Middle East and Africa.

In the intended agreement, Thales's full IP distributed architecture has been designed to provide the public safety and first responder communities with a reliable solution that will improve incident response. The resilience of Thales's LTE distrib-

uted architecture allows dispatchers to successfully communicate messages between several interconnected base stations, towers and first responders even if one of the base stations or towers are out of service.

Nokia Siemens Networks expects to provide its award-winning Single RAN Advanced Flexi Multiradio Base Station to provide LTE access as part of the broader Thales solution.

[www.thalesgroup.com](http://www.thalesgroup.com)



This month's cover depicts the evolving world of communications. Wireless is improving at a rapid rate, but the industry requires tools and test equipment to keep up with the rapid advances being made. In this issue we look at a VNA that reaches 750 GHz on page 17.

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- 12 **CAD/EDA/EM-Software:** Altium Designer makes ultra-high-performance design move faster at Spectrum Integrity  
Spectrum Integrity designs ultra-high-speed digital, RF, and microwave PCBs that process signals at frequencies from 20 to 110 GHz and above. Except for two customers using legacy software, the company now produces all of its designs using Altium Designer. "We can now use a mainstream tool for our ultra high-performance design work, and customize it so we don't have restrictions on getting creative," says Ingham.
- 14 RF and microwave solid-state power amplifiers design requires specialised engineering  
In the world of RF and microwave engineering, the design and development of solid-state amplifiers is a speciality. It has always required many years of specialised engineering experience and a suitable collection of test and measurement equipment. While these will always be necessary, to be successful in the marketplace today, it is also essential to use a combination of specialised and general CAD tools.
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TD-LTE testing must consider test equipment dynamic range, phase and amplitude balancing, and bidirectionality in order to model TD-LTE deployment scenarios including beamforming. To ensure excellent "real world" test of TD-LTE devices and systems, channel emulators can be chosen that both meet the aforementioned requirements and which also provide appropriate automation and channel models that help bridge the field and the lab and enable effective replication of real world conditions in the lab.
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# Wireless SoCs cut consumption free designers from proprietary software frameworks

By Jean-Pierre Joosting

**O**slo, Norway — Nordic Semiconductor have launched the nRF51 Series ULP wireless SoCs, which cut power consumption, increase RF performance, and free designers from proprietary software frameworks.

The first two ICs to debut in the nRF51 Series are the nRF51822, a multi-protocol Bluetooth low energy, 2.4 GHz proprietary RF SoC, and the nRF51422, the first ANT/ANT+ protocol based SoC. The devices share a high performance, lower power 2.4 GHz multi-protocol radio and a 32-bit ARM Cortex-M0 based processor. These enhancements deliver up to 50% lower power consumption, RF link budget improvements of up to 9.5 dB, and over 10x more processing power compared to the company's previous generation of ULP wireless ICs.

A clean partitioned software architecture for the Bluetooth® low energy and ANT™ SoCs frees designers from the integration effort, complexities, and restrictions of chip vendor-supplied software frameworks and instead allows customers to develop their designs quickly and easily using the highly popular and familiar ARM Cortex programming environment. This major benefit is achieved by separating the protocol stack and user application code — providing developers a clean boundary between application and protocol stack, and removes the need to struggle with integration of application code as part of a vendor-imposed application development framework. Code development is now greatly simplified and accelerated and at the same time risks associated with integration of application and stack code are significantly reduced. Customers can expect lower bug rates and improved robustness for their applications.

## Moving to the Cortex-M0

Nordic, which traditionally uses 8051-compatible controllers, has implemented the Cortex-M0 core in the nRF51 Series. The use of the ARM Cortex-M0 delivers up to 10x more processing performance and 100x faster start-up of 2.5 µs from sleep, versus the legacy 8-bit 8051.

Further advantages of the Cortex-M0 core include improved code density, industry-standard tool chain, large software ecosystem, 4.4 mA



peak executing from Flash, and a smooth code migration path.

The processor finishes tasks faster, spending more time sleeping, quickly wakes up using less current starting up, and enables the peripherals to operate autonomously. Here the CPU programs a sequence of peripheral operations and goes to sleep while the peripherals execute their operations. The SoC has no predefined power modes with only those blocks doing something requiring power.

## All about software

The nRF51 offers a different approach to single chip software development. By offering a clean separation of application and stack code, all the application designer sees is a standard Cortex M0. There is no proprietary application framework, no scheduler, no RTOS dependencies. The engineer has full control over the choice of operating environment. The application code and stack code are compiled separately and there are no link-time dependencies. The stack is transparent and run-time protected. Key advantages include independent development, testing and verification as well as code portability, migration and reuse.

## Better radio performance

The multi-protocol 2.4 GHz radio provides high-performance, ultra low power consumption, and flexibility. The radio features -92.5dB receive sensitivity in Bluetooth low energy mode and up to +4 dBm output power in all modes.

The radio delivers a 9.5 dBm improvement in link budget compared to the company's previous generation radio. It is Bluetooth low energy (Bluetooth v4.0) compliant and

offers 100% on air compatibility with Nordic's existing nRF24L series ICs

The radio supports non-concurrent and concurrent operation of a range of protocols including Bluetooth Low Energy, ANT, and proprietary 2.4 GHz RF. Keeping the low-power theme, the radio draws sub-10-mA peak currents running off a 3-V coin cell battery.

## Bluetooth Low Energy

The nRF51822 multi-protocol Bluetooth low energy SoC includes 256 kB on-chip Flash and 16kB RAM, a wide range of digital and mixed signal peripherals including SPI, 2-wire, ADC, and a quadrature decoder, as well as 16 PPI channels. The SoC features a complete Bluetooth protocol stack from Link layer to Profiles.

The S110 Bluetooth low energy stack for the nRF51822 is provided as a downloadable, royalty-free, pre-compiled binary that can be programmed and updated separately. It requires less than 128 kB code space and 6 kB of RAM, leaving more than 128 kB flash and 10 kB RAM for application code.

For proprietary applications the nRF51822 is complemented by an improved Gazell™ 2.4 GHz RF protocol stack providing interoperability with nRF24L Series Gazell-based applications. It consumes 30 percent less than the previous generation nRF24LE1.

## The ANT SoC

The nRF51422 Flash-based ANT SoC is the world's first single chip solution for ANT applications. It is a third generation Nordic ANT solution, and an ideal fit for cost, power, and size-constrained applications such as sports, fitness, and healthcare sensors.

The SoC supports Broadcast, Acknowledged, and Burst communication modes. It provides support for up to eight concurrent ANT channels and a 60 kbps burst rate – 300% faster than previous generation. The nRF51422 requires less than 32 kB of code space and 2 kB of RAM, leaving more than 224 kB of Flash and 14 kB of RAM available for application code.

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# Building the Internet of Things

The Internet of Things has long been touted as the next big wave with predictions of markets of tens or hundreds of billions of devices. While this may come to pass, just connecting devices to the Internet in itself is a pointless exercise. There needs to be a rationale for doing this. For example, does my microwave really need to communicate over the web?

There is another interesting trend in the making, that of the 'Appcessory'. This is basically an application tied to a device such as a blood pressure monitor, heart rate monitor, sports and fitness monitors, peripherals or even a TV remote. Here a mobile phone or tablet can act as the portal to the internet as well as the display if needed. In this scenario, everything tied to a particular individual becomes smartphone or tablet centric. Similarly, intelligent power devices that know how much they consume or have a failure would become app-based. After all, a plug might talk a user's phone to report a fault in the power line, or the microwave could report its consumption. However, such devices do not necessarily connect to the Internet, instead they use a low power wireless protocol such as ANT or Bluetooth Low Energy to talk to an 'app' on the phone or tablet.

Many devices could also talk to each other as well as the tablet or smartphone. Such personal sensor networks could be the way forward in the connected home. Connecting devices to an application gives the device a purpose and the user a reason to use the device in such a way.

However, making this happen requires very low power consumption of the wireless link, so low in fact that energy harvesting looks after the device's energy needs or a coin cell battery powers the device. The battery needs to work for years, if not for the life of the device in question.

Nordic Semiconductor, a specialist focused solely on ultra-low power wireless, is one company making all this possible. They have raised the bar with the release of Bluetooth Low Energy and ANT SoCs that combine the 2.4 GHz radio, software stack and 32-bit ARM Cortex-M0 on a single chip. See page 8 for more details.

It is quite likely the Internet of Things will come to pass, but the majority of such devices will be 'app' centric.

Jean-Pierre Joosting  
Editor (jean-pierre.joosting@eetimes.be)  
[www.microwave-electronics.com](http://www.microwave-electronics.com)

# USB DC -18-GHz coaxial switch... SiO<sub>2</sub> coaxial cables keep phase noise flat... PA covers 71-76-GHz...

## USB-powered, single-pole double-throw coaxial switch covers DC to 18 GHz

Agilent Technologies has announced a USB-powered, single-pole double-throw coaxial switch, operating from DC to 18 GHz. The microwave switch driven by a USB port, the Agilent U1810B will provide system-design and manufacturing engineers a long-operating-life solution with convenient RF switching.

The U1810B USB coaxial switch will support the standard plug-and-play functionality of typical USB devices, eliminating the need for additional power adapters or drivers, and simplifying setup. A button on the switch will enable users to toggle the signal path between two output ports without using the software interface. These new capabilities will help engineers design switch matrices for telecommunications and electronics/semiconductor manufacturing applications.

The U1810B will deliver a guaranteed 5-million-cycle operating life (though users can expect 10 million cycles to be typical), and guaranteed 0.03 dB insertion loss repeatability. The long operating life helps reduce the cost of test and ensures reliability of the test system throughout its life. The switch's exceptional insertion loss repeatability will help minimize system measurement uncertainty, while maximizing test throughput.

The U1810B's front panel provides an alternative software control interface. Users will also be able to control the switch using various software platforms such as C, LabVIEW or VEE.

[www.agilent.com](http://www.agilent.com)

## Coaxial cables boast superior phase performance

The Times Microwave Systems phase critical product line includes the recently broadened range of PhaseTrack® cable assemblies employing the company's TF-4 dielectric, and SiO<sub>2</sub> dielectric semi-rigid cable assemblies for use in extreme environments.

PhaseTrack® coaxial cables are now available in standard flexible, low smoke flexible, in-the-box flex and semi-rigid versions. Exhibiting superior phase performance with temperature changes, they eliminate the common "phase knee" found in PTFE-based cables. All systems

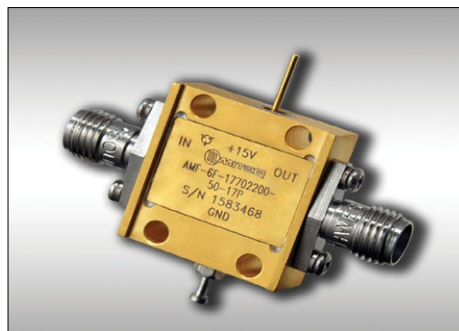
requiring phase stable or phase tracking interconnects will benefit from the performance offered by the PhaseTrack® products, which eliminate PTFE "phase knee", and offer superior absolute phase performance, with tracking better than 50 ppm. The cables feature low insertion loss and VSWR characteristics and come in flexible and semi-rigid versions.

SiO<sub>2</sub> dielectric semi-rigid cable assemblies provide the ultimate in phase tracking performance and support applications with extreme temperature and environmental exposure requirements.

[www.timesmicrowave.com](http://www.timesmicrowave.com)

## Compact coaxial Ka-Band line amplifier

Model AMF-6F-17702200-50-17P has been added to MITEQ's family of Ka-Band, single bias, coaxial line amplifiers. This LNA has over 35 dB of gain from 17.7 GHz to 22.0 GHz, in a housing that is only 0.72-inches long and 0.75-inches wide without the field replaceable K-connectors.



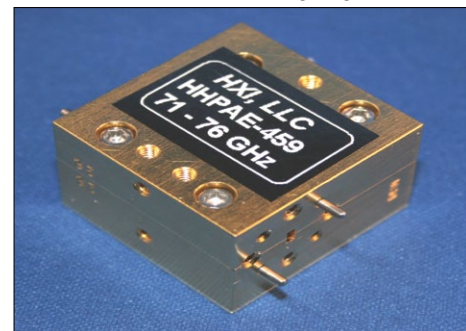
Gain flatness is a maximum of 3.0 dB peak-to-peak, though typical is less than 2.0 dB. The AMF-6F-17702200-50-17P has a maximum noise figure of 5.0 dB in the full band, though the typical value is less than 3 dB. It operates from -40 to +75°C of base temperature, has a P1dB minimum of +17 dBm, output IP3 of typically +25 dBm, and a current draw of 300 mA maximum from a single +15-V DC supply. Port VSWR is typically less than 2:1 for both input and output.

An aluminum case provides excellent thermal characteristics. Hermetic sealing and low noise figure options are available.

[www.miteq.com](http://www.miteq.com)

## High reliability power amplifier covers 71 to 76 GHz

The HHPAE-459 power amplifier, available from Renaissance Electronics covers the frequency range from 71.0 to 76.0 GHz. It has an output P1dB of +18 dBm with small signal gain of 29 dB.



MMIC technology is employed for high reliability and repeatability. A single +6.5 VDC bias feeds an internal voltage regulator and bias sequencer to power the amplifier, freeing the user from the complications of a dual bias configuration.

The amplifier was designed for use in transmitters for E-Band radio communications systems.

[www.hxi.com](http://www.hxi.com)

[www.rec-usa.com](http://www.rec-usa.com)

## Multiplied phase locked oscillators deliver low phase noise

API Technologies has announced a line of multiplied phase locked oscillators offering a phase noise performance of -175 dBc/Hz (at 100 kHz offset).

The device can use an internal or external 10 MHz reference. With an output range of 80 to 1600 MHz, and the flexibility of the passive multiplier design, these phase locked oscillators can be configured for most military and grounds based applications.

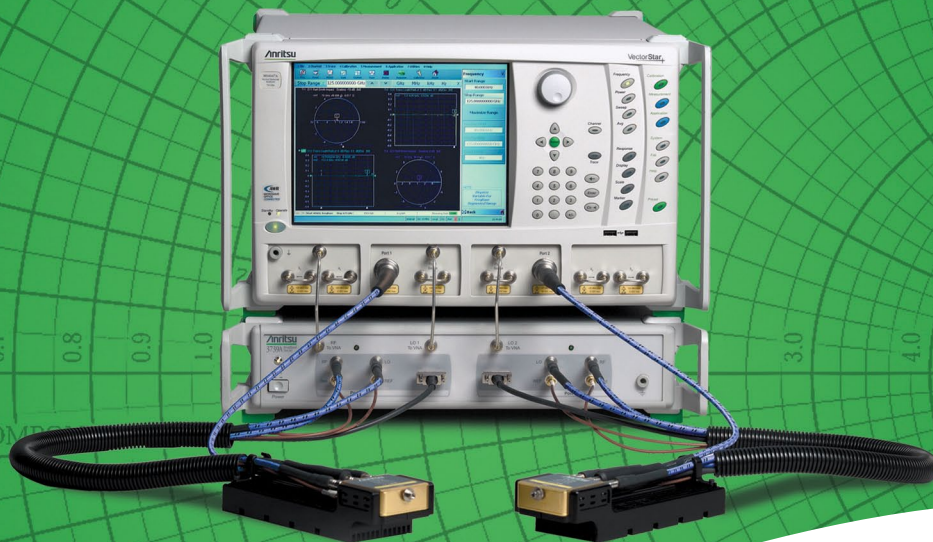
Desired output frequency is increased by using a series of x2 multipliers. The oscillator also delivers excellent spurious performance of -60 dBc when powered by a +12-V supply.

Additional features include: DC voltage regulation, automatic reference sensing, low current consumption and multiple RF outputs.

[www.apitechnologies.com](http://www.apitechnologies.com)



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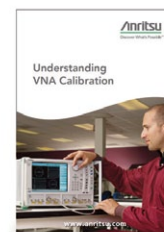
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# Altium Designer makes ultra-high-performance design move faster at Spectrum Integrity

By Michael Ingham, Director of Engineering Spectrum Integrity

Spectrum Integrity designs ultra-high-speed digital, RF, and microwave PCBs which, at 20 to 110 GHz and beyond, are among the most challenging applications in industry. Its customer design challenges require a proprietary “outside the box” process. Yet at the same time, the company must interface with industry standard component libraries as well as the design review processes of its clients.

To design such esoteric designs, the company relies on a collection of very specialized tools. The native schematic capabilities in such tools have proved completely unusable. Spectrum Integrity had to rely instead on a third-party schematic tool that prevented synchronization of layout and schematic and no cross-probing capability. The process had become too disjointed.

Furthermore, there was no free external viewer feature for the board designs, and no simple way to export design files. The frequent client reviews were a tedious and long process.

The company had tried to streamline the process using PADS, but its schematic capture tool was similarly inadequate, and its version control was missing critical built-in functionality.

Spectrum Integrity and its customers needed a more integrated design environment that could accommodate the magic of high-speed and RF PCB design.

## Solution

The company has adopted Altium Designer, and has seen an immediate improvement through its advanced features and integration across the design process.

“The Altium schematic program is very powerful,” explains Michael Ingham, director of engineering at Spectrum Integrity. The design suite synchronizes with major component suppliers including Digi-Key, Mouser, and Newark, “an unexpected major benefit that has made our component engineering much more efficient.” It also embeds component information to automate most of the effort of making accurate BOMs.

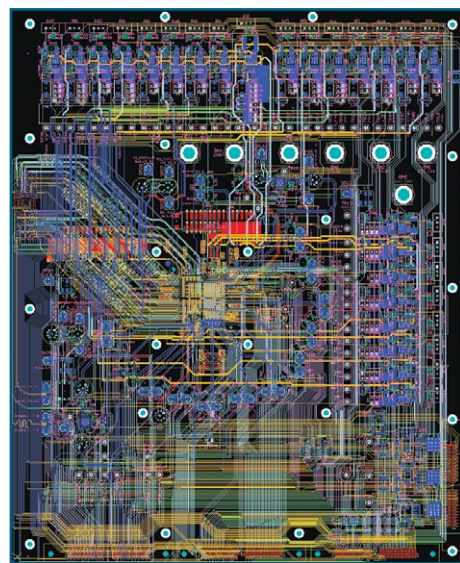
Spectrum Integrity also found it straightforward to customize the Altium Designer environment for the intricacies of

RF design. “We added strategic, proprietary improvements to the tool suite to make them very powerful and efficient for RF and ultra-high-speed digital design,” says Ingham. To streamline interaction with RF analysis, it exports board designs in Gerber data into a 3D field solver. After completing analysis, Altium Designer reads the files back in AutoCAD or DXF format, an easy process that retains net intelligence within the integrated tool suite. Also, Spectrum Integrity reports that creating custom footprints, with non-standard features, is much easier in Altium Designer than its old tool suites.

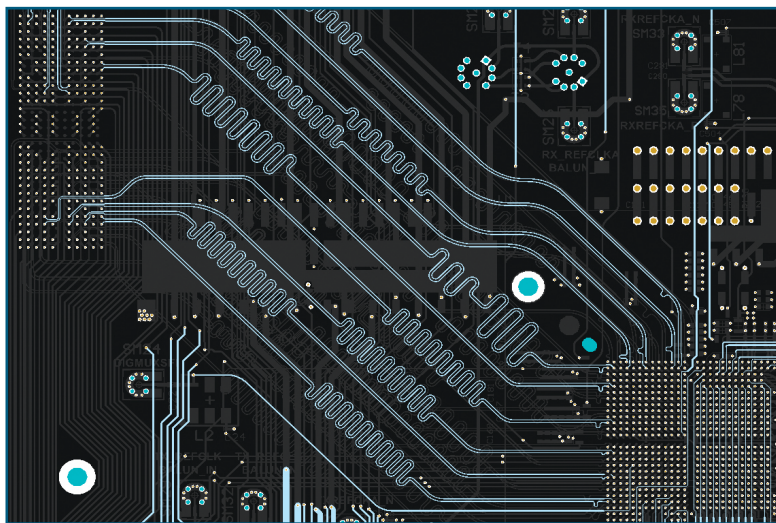
## Automation

Automation within Altium Designer PCB layout helps streamline steps within the design process. For example, the application can apply real-

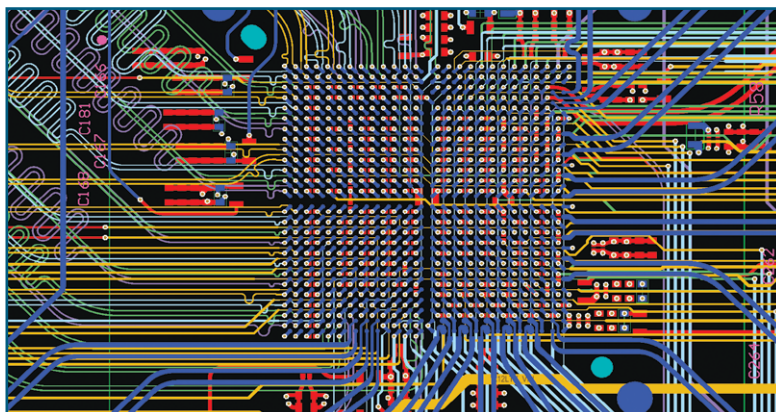
**BGA breakout screen shot.**



**BGA tuned traces.**



**Another BGA breakout screen shot.**



time updating of split power planes during the course of design, saving manual retouching of those planes during design changes. "With our old tools, we would have to manually un-pour and re-pour power planes every time there was a change," says Ingham. "The pour feature in Altium saves us 75% of our time in this step."

*"We can now use a mainstream tool for our ultra high-performance design work, and customize it so we don't have restrictions on getting creative."*

Perhaps the biggest efficiency improvement occurs in data management. The version control features are very important to Spectrum Integrity, because RF designs often require multiple versions stretched across a very extensive review process. In addition, Altium Designer imports and exports across many popular formats, and includes a free design viewer. As Ingham explains, "It's the nature of our designs to produce many versions to share and review." His team has found that even the

relatively simple task of creating PDF check plots has saved considerable process time and prevented the need for a third party program.

#### Results

Except for two customers using legacy software, Spectrum Integrity now produces all of its designs using Altium Designer. "We can now use a mainstream tool for our ultra high-performance design work, and customize it so we don't have restrictions on getting creative," says Ingham.

Altium Designer's ease of use and comprehensive training made adoption quick and painless. "The program was fairly intuitive and we were able to be productive after just a few days of study," says Ingham. "Using the numerous available materials and very helpful videos, my engineers quickly became productive without the need for attending a dedicated training class. They were proficient in about half the time it took for learning PADS."

Customer design reviews are much more efficient with Altium Designer due to the design viewer and automated PDF feature.

"The ease of review allows customer reviews to be much more efficient and thorough, and it avoids unnecessary questions and steps. Our customers are very pleased."

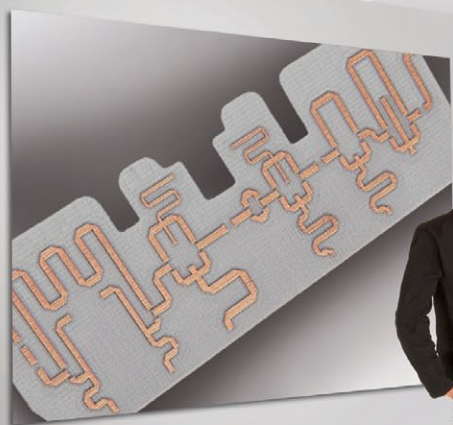
Finally, Altium Designer has automated the generation of Gerber manufacturing files, which saves time and minimizes manufacturing errors.

#### Product

Spectrum Integrity designs ultra-high-speed digital, RF, and microwave PCBs that process signals at frequencies from 20 to 110 GHz and above. The CAD screenshots show 12- and 14-layer ultra-high-speed digital applications successfully designed in Altium Designer. These examples have outer layer traces designed to support 50 GHz signals and multiple inner layer traces designed to support 28 GHz. These designs utilized complex geometries, split power planes, transmission lines, and coplanar vias successfully designed using a combination of Altium Designer and proprietary design techniques.

[www.altium.com](http://www.altium.com)

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## EUROPEAN MICROWAVE WEEK 2012

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European Microwave Week continues its series of successful events, with its 15th at the RAI, Amsterdam, The Netherlands. The EuMW 2012 team are excited to return to this superb city that offers the culture, entertainment and history of a big city, while also affording the charm and warmth of one much smaller. Bringing industry, academia and commerce together, European Microwave Week 2012 will see an estimated 1700 conference delegates, over 5000 visitors and 250 plus exhibitors.

### THE EXHIBITION

Concentrating on the needs of engineers, the event showcases the latest trends and developments that are widening the field of the application of microwaves. Pivotal to the week is the **European Microwave Exhibition**, which offers YOU the opportunity to see, first hand, the latest technological developments from global leaders in microwave technology, complemented by demonstrations and industrial workshops.

**Registration to the Exhibition is FREE!**

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### BE THERE

#### Exhibition Dates

Monday 29th October

Tuesday 30th October

Wednesday 31st October

#### Opening Times

12:00 - 18:00

9:30 - 18:00

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# EUROPEAN MICROWAVE WEEK 2012

## THE CONFERENCES

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- European Microwave Integrated Circuits Conference (EuMIC) – 29th – 30th October 2012
- European Microwave Conference (EuMC) – 29th October - 1st November 2012
- European Radar Conference (EuRAD) – 31st October - 2nd November 2012
- Workshops – 28th - 29th October and 1st - 2nd November 2012

The three conferences specifically target ground breaking innovation in microwave research through a call for papers explicitly inviting the submission of presentations on the latest trends in the field, driven by industry roadmaps. The result is three superb conferences created from the very best papers, carefully selected from close to 1,000 submissions from all over the world. Special rates are available for EuMW delegates. For a detailed description of the conferences, workshops and short courses please visit [www.eumweek.com](http://www.eumweek.com). The full conference programme can be downloaded from there.

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- **ADVANCE DISCOUNTED RATE** – for all registrations made online before 27th September
- **STANDARD RATE** – for all registrations made online after 27th September and onsite

Please see the Conference Registration Rates table on the back page for complete pricing information.

All payments must be in € euro – cards will be debited in € euro.

**Online registration is open now, up to and during the event until 2nd November 2012**

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- Saturday 27th October (16.00 – 19.00)	- Wednesday 31st October (07.30 – 17.00)
- Sunday 28th October (07.30 – 17.00)	- Thursday 1st November (07.30 – 17.00)
- Monday 29th October (07.30 – 17.00)	- Friday 2nd November (07.30 - 10.00)
- Tuesday 30th October (07.30 – 17.00)	

Once you have collected your badge, you can collect the conference proceedings on USB stick and delegate bag for the conferences from the specified delegate bag area by scanning your badge.



## CONFERENCE PRICING AND INFORMATION

### EUROPEAN MICROWAVE WEEK 2012, 28th October - 2nd November, Amsterdam, The Netherlands

**Register Online at [www.eumweek.com](http://www.eumweek.com)**

**ONLINE registration is open from 12th June 2012 up to and during the event until 2nd November 2012.**

**ONSITE registration is open from 4pm on 27th October 2012.**

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Reduced rates are offered if you have society membership to any of the following: EuMA, gaas, iet or ieee

EuMA membership costs: Professional: € 20/year Student € 10/year

Reduced Rates for the conferences are also offered if you are a Student/Senior (Full-time students less than 30 yrs of age and Seniors 65 or older as of 2nd November 2012)

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CONFERENCE FEES	ADVANCE DISCOUNTED RATE			
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1 Conference	Standard	Student/Sr.	Standard	Student/Sr.
EuMC	€ 420	€ 100	€ 550	€ 130
EuMIC	€ 325	€ 90	€ 430	€ 120
EuRAD	€ 255	€ 80	€ 340	€ 110
2 Conferences				
EuMC + EuMIC	€ 600	€ 190	€ 790	€ 250
EuMC + EuRAD	€ 550	€ 180	€ 720	€ 240
EuMIC + EuRAD	€ 470	€ 170	€ 630	€ 230
3 Conferences				
EuMC + EuMIC + EuRAD	€ 710	€ 270	€ 940	€ 360

#### STANDARD REGISTRATION CONFERENCE FEES (AFTER 27 SEPT AND ONSITE)

CONFERENCE FEES	ADVANCE DISCOUNTED RATE			
	Society Member (*any of above)		Non-member	
1 Conference	Standard	Student/Sr.	Standard	Student/Sr.
EuMC	€ 550	€ 130	€ 720	€ 170
EuMIC	€ 430	€ 120	€ 560	€ 160
EuRAD	€ 340	€ 110	€ 450	€ 150
2 Conferences				
EuMC + EuMIC	€ 790	€ 250	€ 1030	€ 330
EuMC + EuRAD	€ 720	€ 240	€ 940	€ 320
EuMIC + EuRAD	€ 630	€ 230	€ 810	€ 310
3 Conferences				
EuMC + EuMIC + EuRAD	€ 940	€ 360	€ 1230	€ 480

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	Standard	Student/Sr.	Standard	Student/Sr.
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# RF and microwave solid-state power amplifiers design requires specialised engineering

By Ivan Boshnakov, Anna Wood, Simon Taylor, Amplifier Technology Ltd

In the world of RF and microwave engineering, the design and development of solid-state amplifiers is a speciality. It has always required many years of specialised engineering experience and a suitable collection of test and measurement equipment. While these will always be necessary, to be successful in the marketplace today, it is also essential to use a combination of specialised and general CAD tools.

The RF and microwave design software we use has removed much of the risk and guess work from creating a new amplifier design. For us, the software design tools have transformed the process of designing an amplifier in terms of speed, substantially shortening the product design cycle and massively improving the probability that the new device will perform as specified at the first attempt.

In the last 10 years or so wide bandgap transistors (SiC MESFETs and GaN HEMTs) have appeared on the market for high power RF/microwave transistors. They offer higher power density and higher voltage operation, which in turn are associated with much lower parasitic capacitances and much higher load-line dynamic resistance, and hence wider bandwidth applications. Of the two kinds the GaN HEMTs offer higher gain performance and became dominant on the market. However, the much wider bandwidth matching networks could not be designed optimally with the traditional Smith Chart and optimisation techniques [1]. The new requirements for broadband high power and high efficiency performance require new and more sophisticated matching networks synthesis techniques such as the real frequency technique [4], [7].

## The design software for the RF and microwave amplifiers

The most important part of the design relies upon extensive use of two RF/microwave software programs which are used in tandem [5]. These are the MultiMatch Amplifier Design Wizard and the general simulator/optimizer Microwave Office [7], [8].

In MultiMatch the designer uses the powerful real frequencies synthesis technique

for lossy and lossless matching network design to achieve the optimum performance from the RF/microwave transistors [4], [7]. The designer can also use the new power parameters (a

properly and fully defined load-line approach) to design power amplifiers [2], [3], [4], [6]. MultiMatch is like a massive amplifier design template where the creation of the schematics

Figure 1: Extraction of design data in Microwave Office.

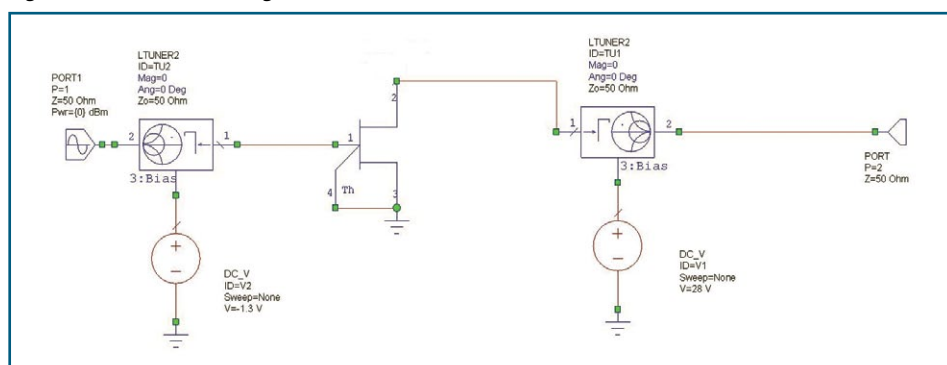


Figure 2: Fitting linear model to the S-parameters in MultiMatch.

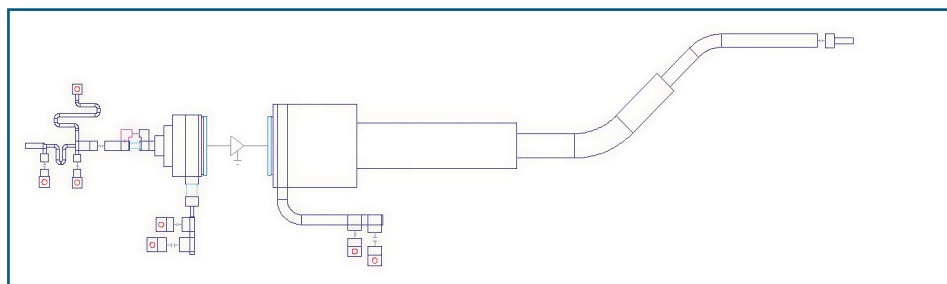
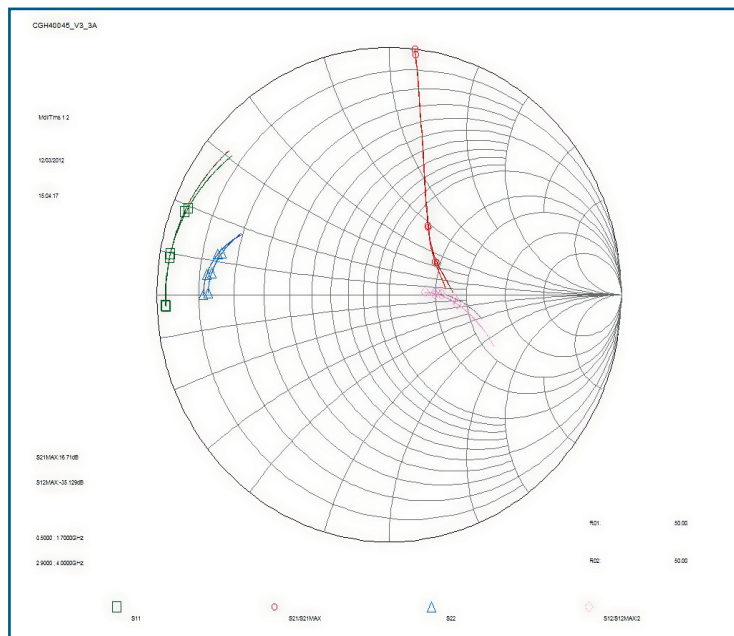


Figure 3: MultiMatch layout.

and layouts is mostly automated to take away most of the boring click-and-drag work with the mouse. Then, with only a few clicks of the mouse, the designed networks are transferred into Microwave Office [8]. The use of MultiMatch is a major departure from the usual Smith Chart matching network design techniques and provides the designer with much higher creativity and productivity.

The networks created this way are then analysed further, and optimised if necessary in Microwave Office using its powerful linear, nonlinear and EM simulation engines. Very often the design actually starts in Microwave Office where the design data (linear models and/

or Load-Pull impedances) are extracted for the design process in MultiMatch. Microwave Office is the friendliest RF/microwave simulation software on the market and provides the highest productivity for small size companies.

The final RF layout created in Microwave Office is then transferred to Altium Designer in which the control and power supply circuits are designed first and then full PCB schematics, layout and Bill of Materials are produced.

The mechanical design is done using Solid Works. Solidworks and Altium, used together are probably the two most productive tools that small companies can use to create the full drawings and documentation.

### The design process

The design process could be started in Microwave Office if there is a nonlinear model of the transistor to be used. Figure 1 shows a basic schematic from which we can determine the capabilities of the transistor and the impedances which have to be presented to the transistor for required performance.

It is also possible, with different set-ups, to simulate IV curves and load-pull contours at frequencies of interest for power, efficiency, linearity, etc., etc.

In cases where a very broadband amplifier stage is required – let's say 0.5- to 2.5-GHz with 45 W Cree GaN HEMT – Figure 1 can be used to extract S-parameters at a biasing point for half the maximum current of the transistor ( $I_{max}/2$ ).

Then the S-parameters are imported into MultiMatch where a linear model is fitted to them – Figure 2.

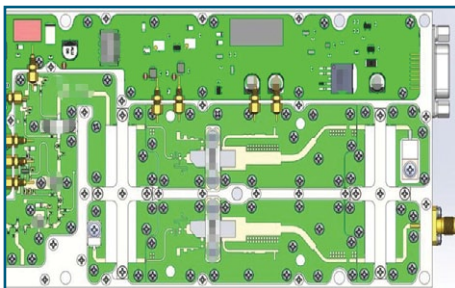
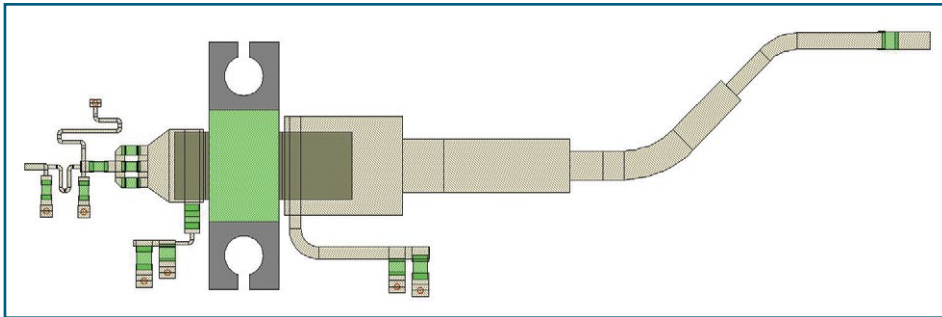
Now, when the maximum current and voltage areas (clipping boundaries) on the IV curves are defined, the novel power parameters are used to synthesize the load impedances for maximum pre-clipped power – the output networks on the right in Figure 3. Then the input lossy (with resistors) and lossless matching and gain equalizing networks are synthesized (on the left in Figure 3).

The layout is manipulated with great ease to the desired shape, and then with a few clicks of the computer mouse the schematic and the layout are exported into Microwave Office (Figure 4). The creation of schematics and layouts are mostly automated in MultiMatch, which saves hours and hours of dragging elements in Microwave Office. Then, in Microwave Office the microstrip discontinuities are fully simulated, either by electromagnetic models or full electromagnetic simulation of parts of the layout. The harmonic balance simulation is used to simulate the power levels of fundamental and harmonic signals, the associated gain and gain compression, currents and voltages, efficiency, etc. Using these simulations some small adjustments would usually be done to achieve the best possible performance.

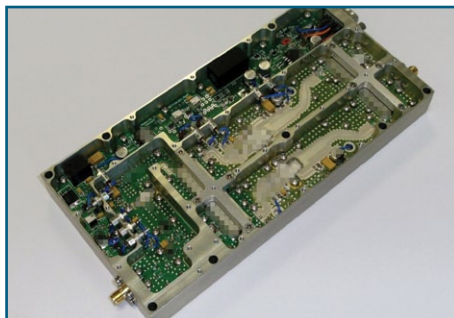
In the fully designed amplifier the stage discussed above is doubled in parallel and combined with hybrid couplers to form a balanced configuration.

There are three more driver stages designed in the same fashion. The layout of the finalized RF/microwave circuits is imported into Altium Designer and Figures 5 and 6 show the full mechanical and PCB design using Altium and SolidWorks.

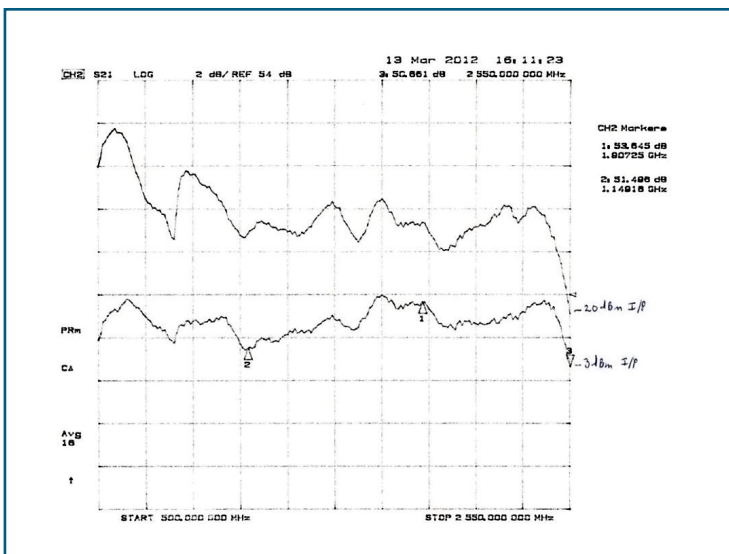
**Figure 4: The layout in Microwave Office.**



**Figure 5: Overall final look of the amplifier after Altium and SolidWorks design process.**

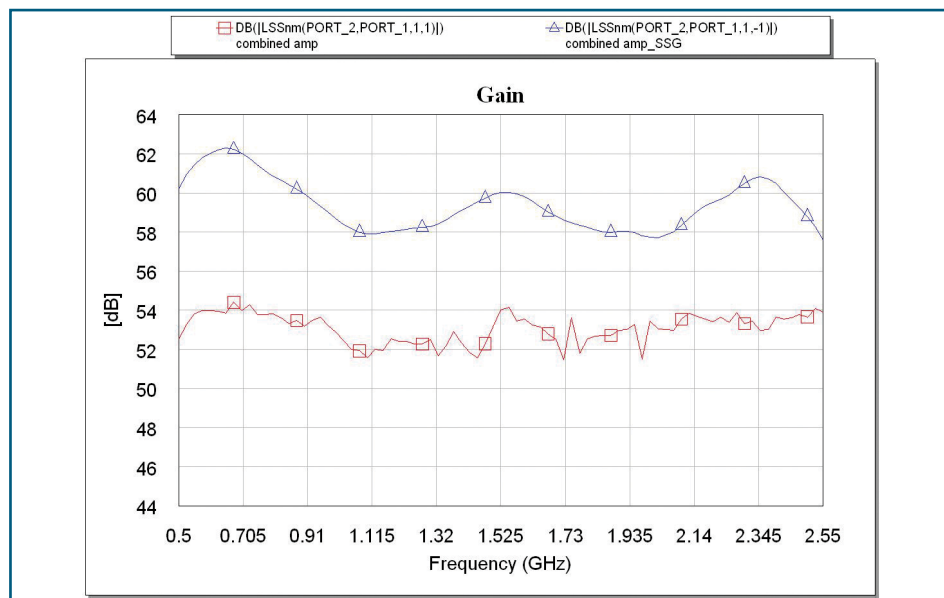


**Figure 6: The photo of the product.**



**Figure 7: Measured Small Signal Gain and Gain at Psat.**



**Figure 8: Simulated Small Signal Gain and Gain at Psat.**

During the testing of the early prototypes, some tuning and adjustments are typically made to the RF and DC/control circuitry, but after the design is finalised, usually very little tuning is done during regular production.

Large parts of the tests during prototype qualifications and tests in production are automated. This helps to shorten the development time and improves productivity. The automated tests are done using standard measurement equipment used with specially built test fixtures and software.

Figure 7 and 8 show comparisons of the measured and simulated small signal gain and the gain at full compression. The results are in very good agreement. The measured output

saturated power is above 48 dBm across the 0.5- to 2.5-GHz frequency band and is again in very good agreement with the simulation.

### Conclusions

Nowadays, you have to design fast and get it “Right First Time” to have any hope of commercial success. The trend is to make amplifiers that are smaller, with higher operational bandwidth, higher power and efficiency, and higher linearity to provide better value for money. An amplifier of the complexity discussed above typically needs to be ready for delivery to the customer in as few as 10 to 12 weeks after the order has been placed, even though the amplifier is often developed from

scratch. To provide that kind of service requires specialised knowledge and experience and also specialised engineering development and production tools.

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8. Microwave Office is a registered trademark of Applied Wave Research, Inc.

## Advanced software tool for PA characterization and visualization

Nujira has released an advanced measurement and data visualization tool for characterizing RF power amplifiers (PAs) in Envelope Tracking (ET) mode. Designated ET Surface Explorer, it accelerates PA characterization, provides PA and product designers greater insight into the performance of ET PAs, and enables them to maximize the linearity, efficiency and output power benefits of operating PAs in ET mode.

The software’s advanced workflow provides a massive productivity boost, replacing thousands of complex, repetitive and time-consuming lab measurements with a single measurement pass, which typically

takes less than two minutes to capture and process. ET Surface Explorer lets designers visualize how PAs behave under live ET supply modulation conditions, unlocking the optimum performance and efficiency characteristics of a given PA. Postprocessing and offline analysis tools create 3D surfaces of gain, phase and efficiency, to give designers far greater insight into ET PA performance. The tool can also automatically generate, model and export a wide variety of shaping tables, including ISOGAIN or Maximum Efficiency.

ET Surface Explorer’s offline analysis and modeling tools allow the designer to rapidly predict and compare application

performance from the comfort of their desk, without requiring multiple test iterations in the lab. The user simply loads an input waveform from disk, specifies the RF power level and selects a shaping table or DC supply voltage. ET Surface Explorer then uses the captured PA surface model to accurately predict adjacent channel leakage ratio (ACLR), efficiency, AM/AM and AM/PM distortion, power dissipation and other parameters in seconds. Selected scenarios can then be re-verified in hardware, and compared against the predictions of the model.

[www.nujira.com](http://www.nujira.com)

# VNA covers single sweep NF measurements over 70 kHz to 125 GHz, extends coverage to 750 GHz

By Jean-Pierre Joosting

Anritsu Company has introduced noise figure measurement capability for its VectorStar MS4640A and ME7838A Vector Network Analyzers (VNAs). Option MS4640A-041 equips VectorStar with 70 kHz to 125 GHz noise figure measurement, enabled in part by a unique receiver optimized for measurements from 30 GHz to 125 GHz.

An example of Anritsu's technical leadership is embodied in the receiver used to perform industry-first VNA-based noise figure measurements at 125 GHz. It incorporates a unique design focusing on improved noise performance and reduced sensitivity to source impedance. The result is a robust capability to make high quality microwave and millimeter-wave noise figure measurements on a wide variety of active devices.

For less experienced test engineers, configuring a noise figure test setup can be particularly challenging, as is often necessary to add pre-amplification and filtering in front of the measurement receiver to ensure sufficient sensitivity to make a quality measurement. If too little amplification is used, there may be excessive jitter from the instrument A/D converter. If too much power or amplification is applied, compression can impact the measurements.

These two constraints form the effective noise figure measurement range and can limit the flexibility a user has in choosing pre-amps and filters. The MS4640A-041 option takes advantage of the high-performance VectorStar architecture to provide a wider noise figure measurement range and greater configuration flexibility. In addition, the use of a simple, low-cost termination is possible, rather than a specialized noise source, as part of the cold source noise figure measurement method. These advantages result in an easier to use, more flexible test system.

The VectorStar series already includes features such as a unique gain compression capability where a user can display gain compression at up to 401 frequencies to characterize performance over a DUT's operating bandwidth in one step. If there is a need to perform active device testing at the wafer level, the VectorStar platform can utilize active and passive tuning of source and

load impedances to help account for both fundamental and harmonic content ensuring optimum DUT performance during test.

## 4-port measurement to 110 GHz

The VectorStar ME7838A broadband VNA platform now also offers 4-port measurement capability, bringing the inherent advantages of the VectorStar platform to 4-port and differential millimeter-wave (mm-wave) component development. Featuring best-in-class stability and power level control, as well as frequency coverage of 70 kHz to 110 GHz in a compact design, the ME7838A offers R&D engineers a highly accurate test tool that reduces measurement times, controls cost-of-test, and helps improve time to market.

The ME7838A broadband VNA system utilizes an advanced design that eliminates the need for large, heavy mm-wave modules and coax combiners. This design allows the ME7838A to be mounted on a smaller probe station using standard positioners. Direct connections to the probes can be achieved in a 2 port configuration due to the design, further reducing space requirements, while eliminating high-frequency cable loss and improving the system's raw directivity. In a 4 port system the compact size of the mm-wave modules means short RF cables can be used to provide best available dynamic range and performance. Because of this, the ME7838A delivers industry-best stability and longer measurement cycles between calibrations.

The system configuration includes the MS4640A VectorStar and 3739A test set, which operates the mm-wave modules. In addition to claiming the widest broadband frequency coverage, the ME7838A system also claims best-in-class RF performance, due to a real-time power leveling control that provides the best power accuracy and stability to power levels as low as -55 dBm. The system has industry-best dynamic range of 108 dB at 65 GHz and 107 dB at 110 GHz, and the fastest measurement speed of 55 ms for 201 points at 10 kHz IFBW.

**VectorStar ME7838A broadband VNA platform provides single-sweep 4-port coverage from 70 kHz to 110 GHz.**



## Millimeter-ranges to 750 GHz

A 4-port configuration for the ME7838A VectorStar VNA extends the measurement system's capability to 750 GHz and higher. Incorporating a number of design features that result in high performance, the ME7838A provides R&D engineers designing 4-port or differential millimeter-wave (mm-wave) components with the ability to sweep power across a wide range at frequencies up to 750 GHz using external mm-wave modules without the need for manual attenuators.

The VectorStar ME7838A mm-wave VNA system offers real-time power leveling and high stability with wide power level control. It detects IF and RF power and provides correction to the mm-wave power in real time and without the need for software correction feedback. The method delivers stable mm-wave power even at low levels and reduces the risk of overdriving power-sensitive mm-wave devices – inherent in other systems. Faster power calibrations are also achieved with the ME7838A VectorStar, compared to competitive mm-wave VNAs, helping to reduce test time and cost of test.

A 2-port system configuration includes the MS4640A VectorStar and 3739A/SM6522 test set, which operates mm-wave modules.

The VNA system can accurately test 4-port components, as well as differential devices, such as amplifiers used in e-band communications, automotive collision avoidance, airport radar, materials measurement, and imaging systems.

[www.anritsu.com](http://www.anritsu.com)

# Testing TD-LTE with real world test technologies

By Erik Org, Senior Marketing Manager, Azimuth Systems

Many wireless data networks were initially designed to offer symmetrical data capacities as the original killer wireless application, voice, required equal capacity for both uplink and downlink. Spectrum blocks were licensed and auctioned as paired spectrum suitable for Frequency Division Duplexing (FDD) protocols, which served carriers and subscribers well when voice was the primary application.

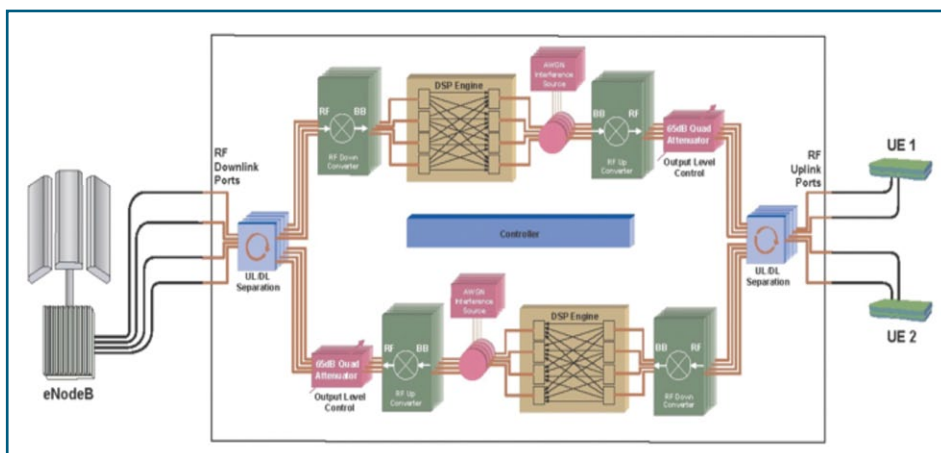
However, as broadband data services have rapidly expanded, the demand on the network has become asymmetrical. In other words, the downlink and uplink loads on the network are no longer balanced as subscribers typically request (and download) much more content than they upload. With a symmetrically provisioned data service, the asymmetrical data demand will rapidly cause the uplink to become underutilized as downlink capacity is reached.

Time Division Duplexed (TD) protocols have an advantage in this situation since the relative allocation of bandwidth between uplink and downlink can be adjusted by adjusting the scheduling of uplink and downlink transmissions. With effective scheduling, carriers can operate their networks at a higher level of utilization than one which was built on a symmetrical model. TD-LTE allows bandwidth allocations to be dynamically modified and uplink and downlink transmission schedules within a single channel can be updated, depending on the particular needs of the network. This enables carriers to operate LTE networks at a higher level of utilization.

The key to a robust and reliable TD-LTE test methodology is to ensure that test equipment supports several key requirements. In the real world, the uplink and downlink coexist in the same spectrum, so effective test equipment designed to support successful TD-LTE deployments must also provide these same features. In particular, test equipment must support bidirectional testing and have phase and amplitude balanced uplink and downlink channels.

Advanced wireless test equipment such as a channel emulator can provide the real world environment necessary for TD-LTE Test. Integration of channel emulators within test solutions that support device and infrastructure testing provides test results that more closely

**Figure 1: Schematic representation of a point-to-multipoint test case with channel emulation showing a fully bi-directional MIMO channel to each UE for realistic recreation of over-the-air conditions.**



reflect what happens in the real world. With the growing demand for bandwidth and the development of MIMO based protocols, channel emulators that can also support both the RF requirements for TD-LTE testing as well as implement the correlation models typical of real world activity are essential to effective testing.

## Requirements for real world testing of TD-LTE systems and devices

MIMO protocols such as LTE are now impacted more than ever by the changing nature of the “real world” radio environment and are significantly affected by the degree of correlation exhibited by the channel models used during test. While basic conducted testing uses standard channel models, more advanced test solutions can enable test of TD-LTE solutions both over the air and with replicated radio field conditions in the lab.

Standard laboratory testing completed using wired connections produces repeatable results but lacks the “real world” and “through the antenna” aspect of over-the-air testing. While over the air tests (such as drive tests) represent the real world, testing such as drive testing lacks repeatability. This is because there are many variables which impact performance during a real world test, for example, channel conditions could change depending upon seasonality and network loading; real world testing such as drive testing is also expensive to perform.

To bridge this gap between laboratory and real world over-the-air testing, channel emulators are deployed in the laboratory testbed.

Channel emulators replicate real world channel propagation conditions in a controllable and repeatable fashion through the use of complex channel models and multiple, programmable parameters (figure 1). Sophisticated channel emulators offer bi-directional operation (simultaneous activity in downlink and uplink directions) with independent programmability of channel characteristics in both directions. By using channel emulators, radio designs and performance can be verified, test coverage can be improved, test cycles decreased and higher quality products can be introduced to the market in a shorter period of time.

Data communications technologies, as employed in TD-LTE, demand high system dynamic range and excellent RF fidelity. These radio systems often employ advanced digital modulation technologies to increase capacity. An example is 64QAM (Quadrature Amplitude Modulation) that carries six bits per symbol per OFDM subcarrier. In addition, techniques like OFDMA improve the operation of the system and allow for scalable capacity. These techniques, coupled with multiple antenna technologies, MIMO, ultimately result in system operation that can provide scalable, reliable capacity to mobile stations with aggregate downstream data rates in excess of 100 Mbps and upstream data rates in excess of 50 Mbps.

But these increases do not come without some cost. Higher order modulations demand high dynamic range and linearity. A 64QAM signal may need in excess of 20 dB SNR to achieve better than desired maximum block



error rate. OFDM systems transmit many small subcarriers which introduces wide changes in instantaneous power level; a peak to average power ratio (PAPR) greater than 10 dB may not be uncommon. And, with frequency selective fading environments typical of mobile communications, certain OFDM subcarriers may be deeply faded while others may not, further increasing the demand on dynamic range. The TD-LTE standard currently implements the uplink with SC-FDMA and was specifically designed to reduce the impact of deeply fades and therefore reduce the power consumption of the UE.

#### Channel emulator input dynamic range

There are several considerations associated with input power when choosing a channel emulator for use with a 3GPP TD-LTE device. These considerations include input power range, peak power and signal-to-noise margin.

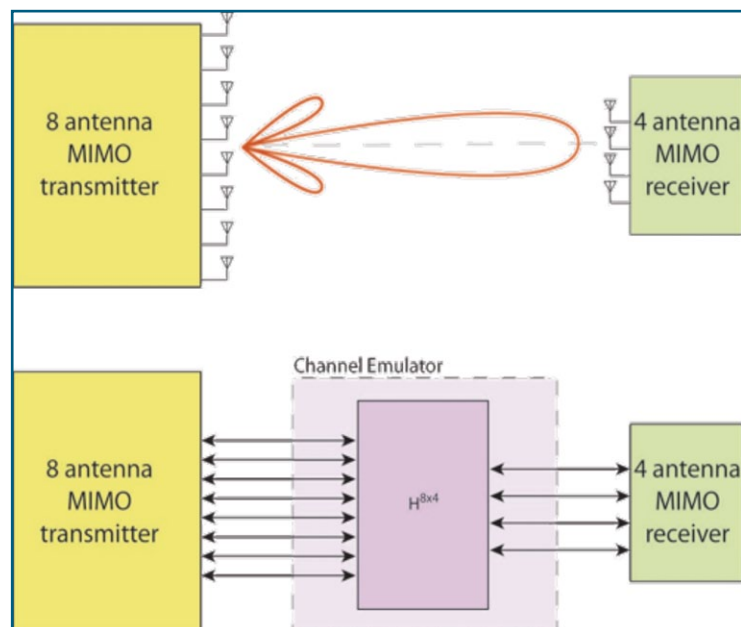
The transmitted signal from the 3GPP LTE device can have a very wide dynamic power range. Although the average power may have some maximum value, when OFDM is employed, the PAPR can be greater than 10 dB, and hence the system must accommodate this maximum. Even with SC-FDMA as employed in transmitters for 3GPP TD-LTE UE devices, PAPR is still present and may be 8 dB or more. Mobile devices also implement transmit power control to vary their output power, typically as a function of their distance from the eNodeB. TD-LTE transmit power control may result in 63 dB or more of actual power change. Furthermore, when the device is transmitting a higher order modulation, such as 64QAM, an adequate signal to noise ratio (SNR) must be maintained. When interfacing with a 3GPP TD-LTE UE, a channel emulator that can allow for direct connection of devices that transmit from +23 to -40 dBm, and still allows for sufficient PAPR and SNR margin, provides for a robust and efficient test configuration.

#### Bidirectionality and phase balance

A time division duplexed signal poses a unique challenge to test equipment design. The signal path through test equipment used for FDD protocols isn't required to support phase balance when conducting bidirectional testing since the uplink and downlink both work in different spectrum and follow their own pilot.

A TD protocol however requires that both uplink and downlink paths be balanced in order to correctly emulate a bidirectional connection. This is especially important as the base station is

**Figure 2:**  
**Beamforming.**



able to use information from the uplink to control the downlink transmission.

#### Fading and noise floor

A fading channel emulator is employed to provide realistic fast fading conditions; ideally, the emulated fading will match that observed by a subscriber using the devices on the service provider's network.

With an OFDM signal, as used in 3GPP TD-LTE, certain subcarriers may be faded, or momentarily reduced in amplitude by 20 dB or more due to the frequency selective fading. As each subcarrier is a modulated signal, with modulation up to 64QAM, this momentary drop in signal amplitude must be considered relative to the noise floor of the channel emulator equipment.

For example, if a signal with an average output power of -40 dBm is momentarily reduced by 20 dB due to fading, the amplitude will be -60 dBm. To maintain an adequate SNR for 64QAM at 25 dB, the test equipment noise floor should be no more than -85 dBm. Noise floor is often expressed by test equipment vendors as a noise power spectral density. Assuming 25° C and a 10 MHz wide signal as would be typical for 3GPP LTE, the noise power spectral density of the test equipment would need to be less than -155 dBm/Hz to insure that the signal fidelity was maintained even during fading conditions. If the noise floor was greater than this, it is possible that as the emulator provides the fading channel, the emulator could also introduce a noise level that will cause demodulation errors in the receiver as a direct result of the channel emulator noise floor and not of the device under test.

#### Implications of beamforming

In the TD-LTE environment, many service providers and equipment vendors have been considering beamforming in deployments. By focusing the transmission energy in beams:

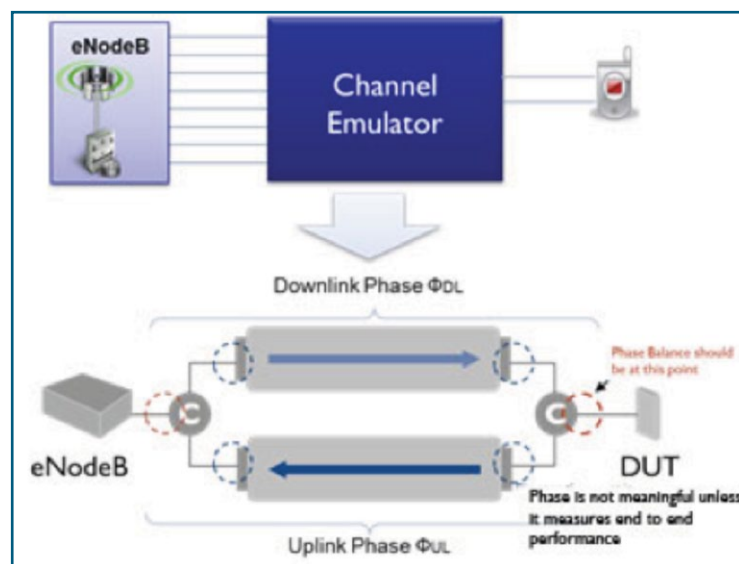
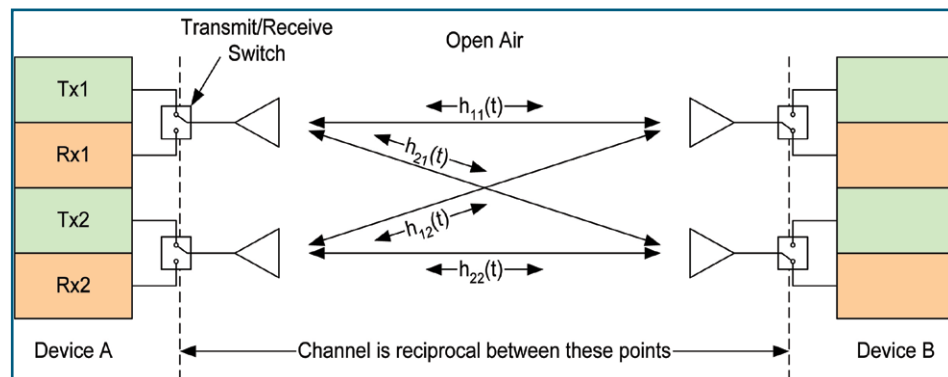
- Higher range can be reached;
- Less energy can be used for the same range;
- Interference can be mitigated;
- Network capacity can be increased;
- Overall improvements in system performance.

Beamforming algorithms are distinguished on the basis of the algorithm used to select the "beamformer." With regards to TD-LTE, one must consider that "air" is reciprocal in nature; i.e. the downlink wireless path looks exactly like the wireless path in the uplink. There may also be multipath reflections, wireless channel variations, phase changes etc. as the signal traverses the wireless environment. In general, beamforming algorithms utilize the characteristics of the air interface such as channel variations and reciprocity.

Channel emulation provides a methodology to reproduce over-the-air conditions in the lab for testing and benchmarking different devices. Channel emulation can be used to validate improvements and performance gains due to beamforming algorithms. However, robust test of a beamforming device in the lab will require the use of a channel emulator that is bidirectional and has reciprocal and balanced paths in a cabled lab environment (figure 2).

This is because beamforming algorithms depend on uplink phase and amplitude information to steer the downlink antenna field pattern. Channel estimates and other signaling

**Figure 3: Transfer functions of a beamforming MIMO system. Note that the channels must be reciprocal from end to end and not just internally to the emulator.**



**Figure 4: Phase equivalence of uplink and downlink.**

information are exchanged continuously between the BS and the MS and hence a bi-directional connection needs to be provided in the lab. Reciprocity means that transfer functions for each path in a MIMO system look exactly the same in both directions and the impulse responses  $h_{ij}(t)$  must be identical for both directions (figure 3).

In practical terms, the test equipment used for beamforming must ensure that the phase of the downlink channel should be calibrated to be equal to the phase of the uplink channel i.e.  $\Phi_{DL}$  needs to be equal to  $\Phi_{UL}$ , the balance should be end to end i.e. right from the point of the connection of the antenna port of the eNodeB to the point of the connection of the

antenna port of the MS and similar amplitude balancing may be required for UL and DL paths (figure 4).

#### Impact of network loading on cell edge performance

At the edge of a cell, a terminal device typically raises its transmit power to the maximum permissible in order to ensure continued robust communications. However, this quickly leads to the situation where the terminal device is only able to transmit one resource block in any given time period. Any attempt to transmit more than one resource block would necessarily spread all available transmit power across more resource blocks and reduce max range.

However, TD-LTE will in reality deliver cell edge performance comparable to FDD performance, since almost all cells will typically have more than one user and thus each device would be limited to a single resource block per unit time irrespective of the max capacity of TD-LTE or FDD LTE.

Verification of this performance can be accomplished using a variable AWGN noise source. AWGN noise is a good approximation of the noise seen by a device due to other sectors/cells in the vicinity of the terminal device.

#### Conclusion

The rising demand for wireless broadband data is driving the adoption of TD-LTE around the globe. With TD-LTE, the allocation of bandwidth can be modified by adjusting the scheduling of uplink and downlink transmissions on a single channel depending on the particular needs of the network. This enables carriers to operate LTE networks at a higher level of utilization, but the protocol poses a unique challenge to equipment design as it requires that both the uplink and downlink paths be balanced in order to correctly emulate a bidirectional connection.

TD-LTE testing must consider test equipment dynamic range, phase and amplitude balancing, and bidirectionality in order to model TD-LTE deployment scenarios including beamforming. To ensure excellent "real world" test of TD-LTE devices and systems, channel emulators can be chosen that both meet the aforementioned requirements and which also provide appropriate automation and channel models that help bridge the field and the lab and enable effective replication of real world conditions in the lab. One good example of such a channel emulator is Azimuth Systems' ACE MX MIMO Channel Emulator. The ACE MX channel emulator is designed to easily support bidirectional testing and because it includes internal isolators and circulators, is delivered to customers with phase and amplitude balanced channels -- which ensures that regardless of the customer's testbed, Azimuth's real world solutions deliver excellent performance for real world TD-LTE testing.

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## RF power transistors offer high efficiency and power density

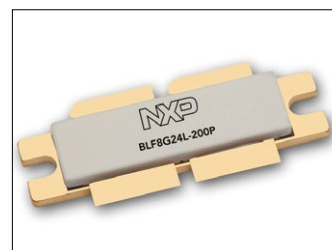
NXP Semiconductors is expanding their eighth-generation (Gen8) LDMOS RF power transistor portfolio for wireless base stations, featuring excellent linearized efficiency, gain and wideband capability.

Covering all main cellular frequency bands between 700 to 2700 MHz, the latest version

of NXP's proven LDMOS process increases the efficiency of Doherty amplifiers by as much as three points and improves gain by as much as 1 dB. The Gen8 LDMOS RF power transistors offer up to 115 MHz of signal bandwidth to enable full-band operation for all cellular frequency bands,

including GSM, W-CDMA and LTE, as well as unprecedented video bandwidth up to 300 MHz.

Designed for cost-sensitive applications, the Gen8 LDMOS transistors offer P1dB powers up to 270 W in SOT502-sized packages, and 400 W in SOT539-sized packages.



Engineering samples of 17 product types are now available.

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## Copper-moly-copper packages suit power semiconductors to 6 GHz



The LL family of leaded laminate copper-moly-copper (CMC) base packages from StratEdge dissipates heat from high power compound semiconductor devices, such as gallium nitride (GaN), gallium arsenide (GaAs), and silicon carbide (SiC).

These packages handle applications through 6 GHz for use in RF radios for communications, radar, and high power millimeter-wave signals. The series includes two laminate power packages, both with a ratio of 1:3:1 CMC, which provides a good thermal match for alumina-based materials and a GaN chip.

The LL802302 is 20.32- x 9.91-mm wide with 2 leads and a raised lid with an epoxy seal. This is a flange package with a bolt hole on each end so the package can be bolted to the printed circuit board. The LL362302 is a flangeless, fully hermetic version of the LL802302 package, and has a flat ceramic lid.

StratEdge offers both flange and flangeless styles to accommodate manufacturing processes to either bolt down or solder the package. Hermeticity is especially critical in aerospace and defense applications.

[www.stratedge.com](http://www.stratedge.com)

# SPACE HERITAGE

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of Innovative  
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K&L Microwave has contributed to the aerospace industry for forty years and has been part of the following programs:

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- Mars Opportunity Rover
- Mars Spirit Rover
- Iridium Satellite Constellation
- CHIRP
- GPS-3
- GPS-R
- V-Sensor
- Thuraya
- MSV
- OCEANSAT 2
- COSMO
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Voltronics, the Trimmer Capacitor Company, is now located at the K&L Microwave facility in Maryland. An experienced manufacturing and engineering staff is available to offer the same well-respected and extensive line of products.

[www.voltronicscorp.com](http://www.voltronicscorp.com)

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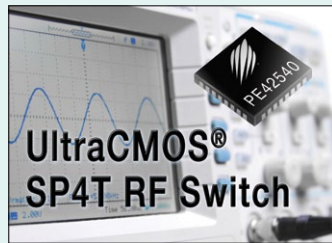
## High-linearity switches

### meet stringent Band XIII 4G LTE requirements

The HaRP™ technology-enhanced SP10T PE426161 switch from Peregrine Semiconductor meets the stringent second-harmonic (2f0) requirement of -80 dBm for Band XIII 4G LTE — making it the highest-linearity switch in the Peregrine portfolio.

The SP12T PE426171 switch features 12 fully-symmetrical transmit ports that give designers the flexibility to freely configure any combination of ports for any mode, and any band, through the bi-directional, two-wire serial-bus control interface. Both of the switches are MIPI compliant, and have a wide supply range of 2.3 to 4.8 V for operation from VBAT, as well as high ESD tolerance of 4 kV Human Body Model at the ANT port, and 2 kV all pins. Both switches also include an on-chip SAW filter over-voltage protection.

In addition to eight symmetric TX ports, the



PE426161 switch features two Super TX (STX) ports that each support low insertion loss of 0.20 dB at 700 MHz, and 0.55 dB at 2690 MHz. The eight symmetric TX ports feature low insertion loss of 0.35 dB at 900 MHz, 0.45 dB at 1900 MHz, and 0.60 dB at 2690 MHz.

The high-isolation PE426171 switch supports four LTE bands, six UMTS bands and four GSM bands, with co-banding applied. This switch has low insertion loss of 0.35 dB at 900 MHz, 0.45 dB at 1900 MHz, and 0.60 dB at 2690 MHz; and high isolation of 38 dB at 900 and 1900 MHz, on all paths.

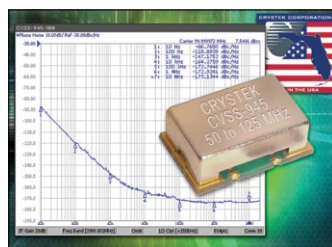
[www.psemi.com](http://www.psemi.com)

## SMD true sinewave VCXO

### delivers -172.9 dBc/Hz noise floor at 1 MHz offset

Crystek Crystals has launched the CVSS-945 — a true sinewave voltage controlled crystal oscillator (VCXO) providing -172.9 dBc/Hz noise floor at 1 MHz offset and  $\pm 20$  ppm minimal APR pullability. This high-performance VCXO is available in the industry standard 9 x 14 mm SMD package and is engineered to MIL-STD-883 and MIL-STD-202 specifications.

The CVSS-945 VCXO generates frequencies between 50 MHz and 125 MHz, with output level of +5 dBm min



into 50 Ohms and harmonics lower than -25 dBc. The CVSS-945 consumes 30 mA maximum current at 5.0-V and generates no sub-harmonics. An extended temperature range of -40°C to +85°C and other custom specifications are also available.

[www.crystek.com](http://www.crystek.com)

## Low power multi-GNSS platform

### supports GPS/GLONASS/QZSS

Alpha Micro has introduced the u-blox 7 next generation core positioning technology platform designed to support all Global Navigation Satellite Systems (GNSS) - US, Russian, Chinese, Japanese - and EU satellite positioning systems, as well as all Satellite-Based Augmentation Systems.

Based on the UBX-G7020 multi-GNSS receiver IC, u-blox 7 has the lowest power consumption of any such device on the market today by a factor of three compared to other stand-alone solutions.

With 7 mW power consumption during continuous navigation, the u-blox UBX-G7020 is perfect for small portable and power-sensitive devices requiring long battery life, high sensitivity, small size and fast positioning.

The chip has been designed to support the lowest cost stand-alone solution via



minimum eBOM; only 8 external components are required resulting in a receiver occupying only 30 mm<sup>2</sup> on a 2-layer PCB. Standard crystal and TCXO are supported. The chip also provides low-power, autonomous log data output of position, velocity, and time. Support for A-GPS and u-blox's CellLocate hybrid GNSS/cellular positioning technology is embedded to facilitate advanced telematics applications including indoor positioning. Standard and automotive grades are supported.

[www.alphamicro.net](http://www.alphamicro.net)

## Verilog-A RF device models

### help GaN adoption in 4G/LTE infrastructure

Cree has released a suite of Verilog-A proprietary non-linear device models for its GaN RF devices, developed for use with leading RF design platforms from Agilent ADS and AWR Microwave Office.

The device models support more complex circuit simulations including modulation envelope analysis for use in the latest innovative broadband and multi-mode RF power amplifiers for 4G cellular telecommunications.

"The release of this new suite of device models enables RF design engineers to predict non-linear performance using harmonic balance, conduct robust transient analysis

as well as use "real-world" arbitrary modulation signals with envelope simulation for Cree's GaN HEMT devices," said Jim Milligan, director RF and microwave, Cree. "The Verilog-A models, together with envelope simulators, allow designers to directly investigate higher efficiency circuit approaches, such as Doherty amplifiers, to improve adjacent channel power ratios, spectral re-growth and error vector magnitude, while assessing if amplifier performance meets spectral mask requirements for LTE deployments."

[www.cree.com/rf](http://www.cree.com/rf)



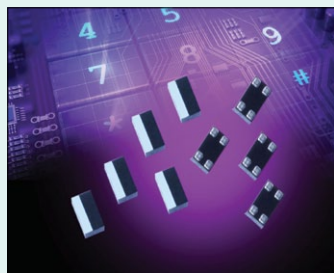
## Miniature wideband coupler

*features high directivity over 700 to 2700 MHz*

AVX Corporation has developed a wideband directional coupler with high directivity. Based on thin-film multilayer technology, which provides the miniature part with excellent frequency performance and rugged construction for reliable automatic assembly, the ITF high directivity LGA coupler features a 0402 chip size, high directivity (20 dB), and a stable coupling factor ( $24 \pm 2$  dB) over a broad frequency range (700 to 2700 MHz).

Compatible with several types of high frequency wireless systems, the coupler is ideal for applications including: mobile communications, satellite TV receivers, GPS, vehicle location systems, wireless LANs, and matching networks.

The ITF high-directivity LGA couplers feature an inherently low profile, excellent



solderability, self-alignment during reflow, efficient heat dissipation, and a power rating of 3 W. Featuring lead-free Sn100 nickel/solder coated terminations, the couplers are compatible with automatic soldering technologies, including reflow, wave soldering, vapor phase, and manual. Rated for use from  $-40^{\circ}$  to  $+85^{\circ}\text{C}$ , the wideband, high-directivity couplers are also 100% tested for electrical parameters and visual characteristics.

[www.avx.com](http://www.avx.com)

## LNA MMICs

*target low noise applications*

Custom MMIC is introducing three devices from its growing MMIC IP/design library. CMD162 is a GaAs MMIC low-noise amplifier (LNA) chip for applications from 26 to 34 GHz.

Optimized for 30 GHz satellite communications, the CMD162 boasts a typical noise figure of 1.7 dB with a small-signal gain of 22 dB and an output 1 dB compression point of +7 dB. This amplifier delivers high performance with high efficiency, reducing typical industry DC power dissipation for a device in this frequency band from approximately 340 mW down to 50 mW.

Two other LNAs include the CMD157 (die) and CMD157P3 (packaged) GaAs

MMICs for applications from 6 to 18 GHz. These broadband devices each feature a low noise figure of 1.5 dB, deliver greater than 25 dB of flat gain, and have a corresponding output 1 dB compression point of +10 dBm.

Both the CMD157 and the CMD157P3 are 50 Ohm matched designs, thus eliminating the need for external DC blocks and RF port matching. The CMD157 is suitable for chip-and-wire applications, whereas the CMD157P3 is housed in a leadless RoHS compliant 3- x 3-mm plastic surface mount package.

[www.CustomMMIC.com](http://www.CustomMMIC.com)

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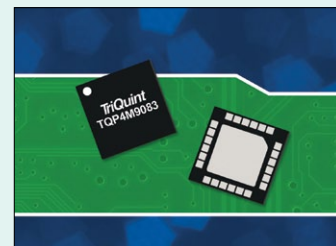
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Phone: (614) 891-2244 Fax: (614) 818-1600  
[info@lakeshore.com](mailto:info@lakeshore.com) [www.lakeshore.com](http://www.lakeshore.com)

## High-speed digital step antenna

*basestation and test applications*

TriQuint Semiconductor has released a 7-bit digital step attenuator (DSA) that delivers the low insertion loss, high speed, linearity and advanced, fine-grain resolution required by designers of base station transceivers, test equipment and many other similar applications. The TQP4M9083 provides up to 31.75 dB of attenuation in 0.25-dB steps and operates from 400 MHz to 3.5 GHz. The finer step increment of 0.25-dB versus the typical 0.5-dB step provides more choices for system gain control.

The attenuator uses a TTL / CMOS-compatible serial peripheral interface (SPI) controller for changing



attenuation states; this maintains high attenuation accuracy over frequency and temperature. Switching speed is 118 ns, input third-order intercept (IIP3) is +55 dBm, and insertion loss is 1.5 dB at 2 GHz. The TQP4M9083 is designed to be robust, meeting stringent Class 1C HBM (up to 2 kV) electrostatic discharge (ESD) requirements.

[www.triquint.com](http://www.triquint.com)

## High-performance front end modules target next generation WiFi applications

RF Micro Devices has announced the release of four high-performance front end modules (FEMs) for next generation WiFi applications.

The RFMD® RFFM8200, RFFM8500, RFFM8202, and RFFM8502 are highly integrated FEM solutions covering multiple WiFi standards and frequency bands, particularly IEEE802.11n and the emerging 802.11ac specification. RFMD's FEMs achieve industry-leading linear power and dynamic error vector magnitude (EVM) performance in support of the newest reference designs from the world's leading WiFi chipset providers.

Dynamic EVM is a critical design specification for high data rate WiFi systems. While competitor solutions have traditionally measured static EVM performance, RFMD's FEMs achieve superior dynamic

EVM to deliver best-in-class real-world WiFi system performance. This enables optimum data throughput at increased operator range, current savings through optimal transmit and receive speeds, and an enhanced user experience during video streaming, gaming, and other high data rate applications.

The RFFM8200/8202 (2.5 GHz) and RFFM8500/8502 (5 GHz) FEMs integrate the power amplifier, LNA, and switch functionality into a single plastic QFN package. Designed for both "chip on board" and "system-in-package" (SiP) implementations, both product families deliver best-in-class linear output power while operating over a wide range of operating voltages.

[www.rfmd.com](http://www.rfmd.com)

## RF signal generator and analyzer add WLAN 802.11ac capability

Aeroflex Limited has added IEEE 802.11ac capability to its S-Series RF signal generator and analyzer product line. Designed for use by engineers in WLAN research, design, and manufacturing, the new 802.11ac capability is available for the SGD RF digital signal generators (Option 119) and the SVA vector signal analyzers (Option 110).

The S-Series product line's standard features include a claim to the industry's widest bandwidth at 200 MHz; level and frequency settling times that are 5x faster than competitors at 100 µs; as well as very low phase noise performance of -135 dB/Hz at 1 GHz, 20 kHz offset. The

instruments feature a 4U height and half-rack width.

SGD's comprehensive WLAN signal generation suite is now updated for 802.11ac, supporting bandwidths of 20, 40, 80, 80+80 and 160 MHz and up to 8 spatial streams. Using an embedded version of Aeroflex's IQCreator® waveform creation software, 802.11ac waveforms are quickly created and played from within the signal generator. Modulation schemes up to 256QAM are supported with excellent residual EVM (Error Vector Magnitude) to pinpoint the exact nature of any signal degradation

[www.aeroflex.com](http://www.aeroflex.com)

## Breakthrough front-end system has all popular 2G/3G/4G bands and switches/filters

Skyworks Solutions has launched a breakthrough front-end system that integrates all RF and analog content between the transceiver and antenna for simplified design within demanding next generation mobile platforms.

SkyOne™ is the first semiconductor device to condense multiband power amplifiers and high throw switches along with all associated filtering, duplexing and control functionality into a single, ultra-compact package — all in less than half the area of the industry's most advanced approach. At the same time, this groundbreaking solution claims the best linearity and power added efficiency (PAE) for smart RF integration. As a result, SkyOne™ offers smartphone, tablet and ultrabook OEMs significant board space savings, ease of implementation, performance and time to market advantages.

Even as radio content and complexity continue to rise, consumers are demanding increasingly thinner and



lighter mobile platforms with increased talk/data access time. To meet this challenge, SkyOne™ optimizes performance beyond what is possible with less integrated devices and incorporates all popular 2G, 3G and 4G/LTE protocols enabling seamless global network roaming and extended battery life.

The SkyOne™ family of FEMs integrate the following in a single package: 2G/3G/4G power amplifiers; support for bands 1, 2, 3, 4, 5, 7, 8, 13, 17 and 20; quad band GSM/EDGE power amplifiers and filters, all associated duplexer functionality, integrated CMOS switches and control functions; and DCS/PCS Rx filters.

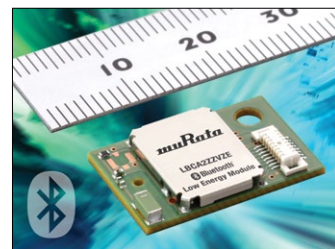
[www.skyworksinc.com](http://www.skyworksinc.com)

## Compact Bluetooth Low Energy module includes chip antenna

Murata has started mass production of a Bluetooth Low Energy (BLE) wireless module that includes a chip antenna and all the Bluetooth protocol stacks required for low-energy communication.

The LBCA2ZZVZE is designed for a broad range of consumer electronics but the module also benefits from healthcare protocol profiles being included in the stacks.

Measuring just 20.0 x 13 x 2.4 mm, and based on the CC2541 Texas Instruments



chipset, the module has an output power of typically -2 dBm and is fully wireless certified to Bluetooth 4.0, TELEC, FCC/IC and CE specifications.

[www.murata.eu](http://www.murata.eu)



## Automotive cellular M2M module claims to be smallest on the market

Cinterion claims to offer the smallest surface mount automotive M2M module available, providing global voice and data communications for vehicle telematics.

The AGS2, measuring 27.6-x 18.8-mm is the company's first offering as an Associate Partner in the Intel Intelligent Systems Alliance program, which provides OEMs and developers with the advanced hardware, software, firmware, tools and systems integration support needed to bring leading-edge technology solutions to market faster.

The AGS2 surface mount module comes in Land Grid Array format and was designed for cost effective vehicle telematics such as fleet

management solutions, car alarms and eCall applications. The module features a secure Internet protocol connection, digital audio and advanced voice technology with voice prompts, which can be crucial during emergencies. Quad-band capability helps eliminate coverage disruptions, providing reliable communications even when roaming between counties and across different carrier networks.

The module's advanced jamming detection feature strengthens theft prevention while its low power consumption helps extend vehicle battery life. Development kits are available.

[www.cinterion.com](http://www.cinterion.com)

## Basestation radio chip set enables active antennas

Unitrx from PMC-Sierra is a three-chip set for base station radios geared to break through mobile network congestion by enabling active antennas. The chips replace as many as 14 discrete devices used in traditional basestation radios.

Up to four Unitrx chip-sets can be linked to support 8x8 MIMO antennas. The extra transmit and receive channels let carriers spread coverage to broader areas and more users than conventional designs.

Carriers are driving power dissipation of base stations from 60 W today to as much as 80 W in some trials to extend their range. "We think smart antennas with MIMO are a better approach to brute force increasing power," said Robert Chow, director of product marketing in PMC's broadband wireless division.

Active antennas will be used in tandem with a new tier of small cell base stations carriers are also testing as a way to extend the coverage of back-haul networks clogged with mobile data. Carriers are still defining just what mix of active antennas and small cells they will support in their next-generation nets.

The three Unitrix chips for basestation antennas consume 8.1 W and 2,900 mm<sup>2</sup> in area compared to as much as 17.6 W and 6,200 mm<sup>2</sup> for the 14 discrettes they replace, PMC said. The chip set covers 400 MHz to 4 GHz to support everything from GSM 2G to LTE 4G networks. The chips include separate transmitter and receiver chips and a clock synthesizer.

<http://pmcs.com>

## Wireless device precompliance testing comes to the lab

Rohde & Schwarz has added three options to its compact DST200 RF diagnostic chamber: the DST-B160 automated 3D positioner, the DST-B210 cross-polarized test antenna and the DST-B270 communications antenna.

These options significantly speed up precompliance testing of wireless devices, allowing automated test sequences to be performed on the lab bench so that developers no longer require constant access to large RF test chambers.

In wireless device precompliance testing, the compact DST200 RF diagnostic chamber now automatically sets the equipment under test (EUT) to the required position. With its latest options the DST200



claims to be the only RF test chamber on the market that enables OTA performance and RSE testing of wireless devices such as smartphones right on the lab bench. Test results are comparable with those obtained with large RF test chambers and are used for product optimization during the design phase — providing an ideal preparation for final compliance testing.

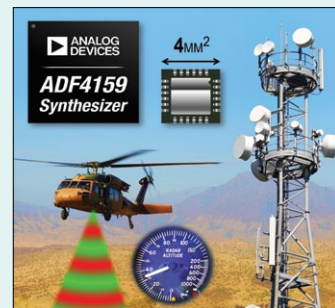
[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## 13 GHz PLL synthesizer achieves phase detector operating frequency of 110 MHz

Claiming to be the industry's highest performance 13 GHz PLL synthesizer, the ADF4159 from Analog Devices achieves breakthrough phase detector operating frequency of 110 MHz and simultaneously consumes less than 100 mW of power, which is 5 times less than competitive solutions.

In addition, it contains a 25-bit fixed modulus as well as on-chip functionality to generate highly linear ramp profiles, making it an ideal solution for Frequency Modulated Continuous Wave (FMCW) radar applications, including automotive radar, microwave point-to-point (PtP), communications instrumentation and test equipment.

The ADF4159 Fractional-N PLL synthesizer consists of



a low-noise digital phase frequency detector (PFD), precision charge pump and a programmable reference divider. It can be used to implement frequency shift keying (FSK) and phase shift keying (PSK) modulation.

The ADF4159 features cycle slip reduction circuitry, which leads to faster lock times, without the need for modification to the loop filter.

[www.analog.com/rf](http://www.analog.com/rf)



# CALENDAR

## EMC 2012

**5th - 10th Aug 2012**

David L. Lawrence Convention Center  
Pittsburgh, PA, USA  
[www.emc2012.isemc.org](http://www.emc2012.isemc.org)

## IBC Exhibition

**6th - 11th September 2012**

RAI Amsterdam  
The Netherlands  
[www.ibc.org](http://www.ibc.org)

## ICUWB2012 - 2012 IEEE International Conference on Ultra-Wideband

**17th - 20th Sept 2012**

Syracuse, New York  
USA  
[www.icuwb2012.org](http://www.icuwb2012.org)

## MM Live, MEMS Live & NANO Live

**25th - 26th Sept 2012**

NEC, Birmingham  
UK  
[www.mmliveuk.com](http://www.mmliveuk.com)

## AMTA 2012 - Antenna Measurement Techniques Association

**21st Oct - 26th Oct 2012**

Hyatt Regency  
Bellevue, WA, USA  
[www.amta.org](http://www.amta.org)

## European Microwave Week

**28th Oct - 2nd Nov 2012**

RAI Amsterdam  
The Netherlands  
[www.eumweek.com](http://www.eumweek.com)

## 2012 Military Communications Conference (MILCOM)

**29th Oct - 01st Nov 2012**

Orlando, Florida, USA  
[www.milcom.org](http://www.milcom.org)

## International RFID Congress 2012 RFID/NFC in Health-Care

**5th - 7th Nov 2012**

Palais de la Méditerranée  
Nice, France  
[www.rfid-congress.com/2012/en](http://www.rfid-congress.com/2012/en)

## Electronica 2012

**13th - 16th Nov 2012**

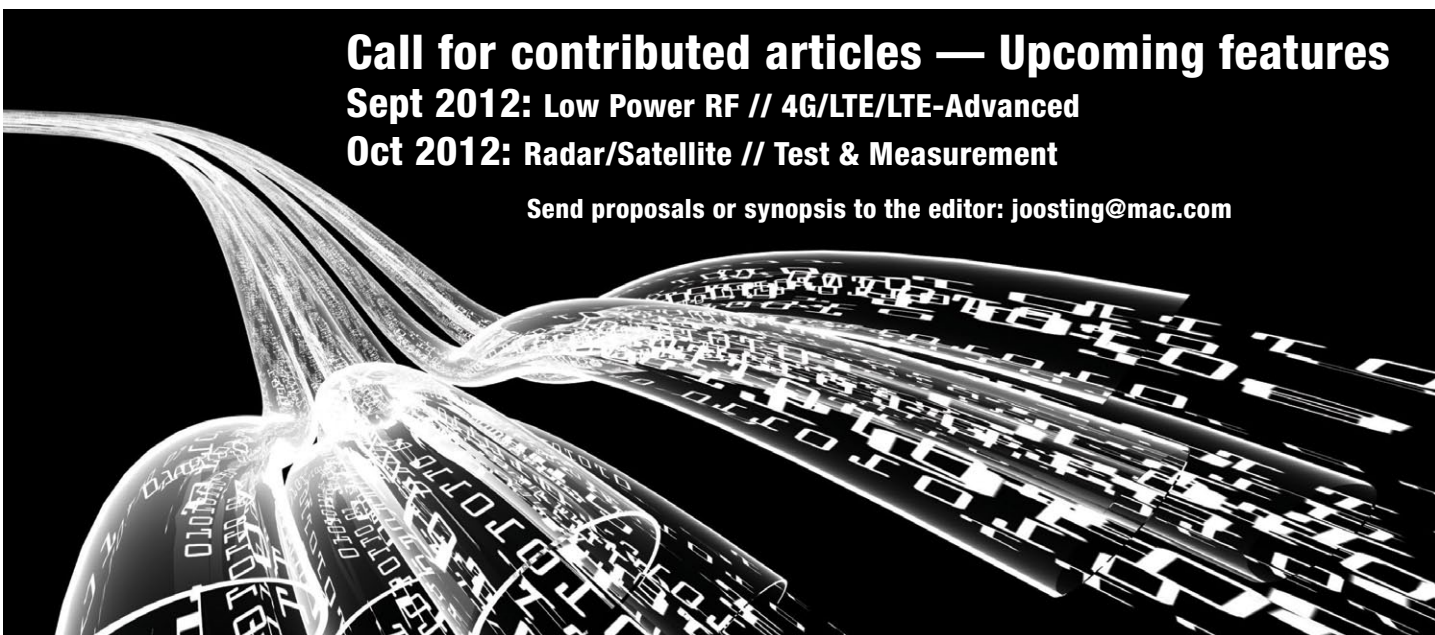
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Send proposals or synopsis to the editor: [joosting@mac.com](mailto:joosting@mac.com)



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# Automotive Electronics



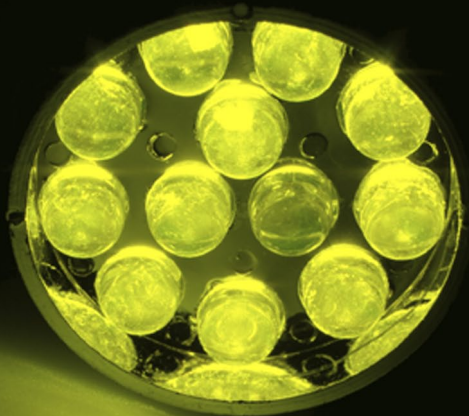
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# Power Management

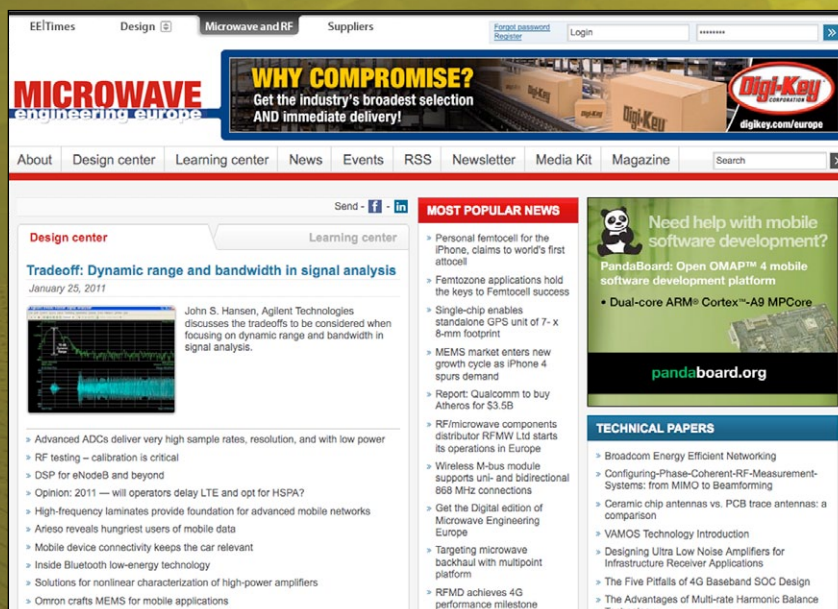


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